APPENDIX C

AIR DISPERSION MODEL

Valley Paving & Asphalt

Facility ID No. 777-00086

P-060024

MEMORANDUM

DATE: February 6, 2008

TO: Jonathan Pettit, Air Quality Permitting Analyst, Air Program

FROM: Kevin Schilling, Stationary Source Modeling Coordinator, Air Program

PROJECT NUMBER: P-060024

SUBJECT: Modeling Review for the Valley Paving and Asphalt, Inc. Permit to Construct Application for Modification to their Portable Hot Mix Asphalt Plant Located in McCall, Idaho

1.0 Summary

This memorandum replaces the September 28, 2006, modeling review memorandum accompanying the DEQ Statement of Basis submitted for public comment in November, 2006.

Valley Paving and Asphalt (Valley Paving), Inc. submitted a Permit to Construct (PTC) application for modifications to their portable hot mix asphalt plant (HMA), currently located in McCall, Idaho. Air quality analyses involving atmospheric dispersion modeling of emissions associated with the modification in operations of the plant were submitted to demonstrate the modification would not cause or significantly contribute to a violation of any ambient air quality standard (IDAPA 58.01.01.203.02 [Idaho Air Rules Section 203.02]). Bison Engineering, Inc. (Bison), Valley Paving's consultant, conducted the initial ambient air quality analyses.

A technical review of the submitted air quality analyses was conducted by DEQ. DEQ also performed an independent, more refined dispersion modeling analyses to evaluate potential impacts of the entire facility. The submitted modeling analyses in combination with, or as revised by, DEQ's staff analyses: 1) utilized appropriate methods and models; 2) was conducted using reasonably accurate or conservative model parameters and input data; 3) adhered to established DEQ guidelines for new source review dispersion modeling; 4) showed either a) that predicted pollutant concentrations from emissions associated with the proposed facility were below significant contribution levels (SCLs) or other applicable regulatory thresholds; or b) that predicted pollutant concentrations from emissions associated with the facility, when appropriately combined with background concentrations, were below applicable air quality standards at all receptor locations. Table 1 presents key assumptions and results that should be considered in the development of the permit.

DEQ staff also conducted a facility-wide air emissions impact analysis for the toxic substances in response to concerns initially identified by the neighboring public and further expressed during the public comment period. This analysis was conducted as per DEQ's authority to evaluate facility-wide compliance with Idaho Air Rules Section 161.

DEQ performed a refined assessment of emissions, dispersion, and risks to potentially exposed public following the November 2006 public comment period. The refined assessment indicated maximum risks to nearby residences and other areas of reasonably expected public exposure are below 10-in-1,000,000 based on a 70-year exposure to carcinogenic substances emitted from the facility. DEQ staff have concluded this risk is within acceptable levels.

Table 1. KEY ASSUMPTIONS USED IN MODELING ANALYSES	
Criteria/Assumption/Result	**Explanation/Consideration**
Impacts from the facility, as evaluated by Bison, were partially based on generic modeling analyses conducted by DEQ for a hypothetical HMA facility, with impacts scaled by the proposed production rates.	DEQ developed a generic, streamlined approach for evaluating impacts from portable HMA plants. This approach was designed to represent impacts associated with a typical HMA plant. However, the submitted analyses did not account for condensable particulate emissions from the drum dryer.
DEQ performed refined analyses based on site-specific characteristics and equipment configurations. DEQ also revised emissions estimates to account for condensable particulate.	Because of the presence of a ready-mix concrete batch plant and a rock crushing plant, DEQ determined it would be more appropriate to use site-specific modeling analyses, rather than the generic, streamlined approach.
Aggressive control of modeled fugitive emissions associated with material handling were needed to enable facility-wide compliance with the 24-hour PM_{10} standards.	Without using the emission factor for wet suppression of emissions from material handling, there were numerous modeled concentrations exceeding the 24-hour PM_{10} standard at locations immediately east of the HMA plant (only about 30 meters from the HMA plant).
DEQ refined analyses demonstrated emissions increases associated with the proposed modifications would not cause or significantly contribute to a violation of the 24-hour PM_{10} standard.	Although conservative facility-wide modeling indicated potential exceedances of the standard at receptors along the road transecting the facility, those impacts were only predicted for the period between October and April (when actual operations are typically reduced), and were primarily a result of potential fugitive emissions from the concrete batch plant also located on the site. DEQ is confident that aggressive control of fugitive emissions from the HMA plant and the neighboring ready mix concrete batch plant and rock crushing plant will ensure NAAQS compliance at all ambient air locations.
Potential impacts of Toxic Air Pollutants (TAPs) associated with the modification are acceptable as per Idaho Air Rules Section 210.	Modeled concentrations from increased emissions of TAPs were below applicable increments (AACs/AACCs).
DEQ determined facility-wide impacts of toxic substances were in compliance with Idaho Air Rules Section 161.	After evaluation of refined modeled air impacts of toxic substances, considering the magnitude and location of modeled concentrations, DEQ determined further analyses (beyond those performed by DEQ and presented in the Statement of Basis) were not necessary to evaluate compliance with Section 161. DEQ's risk assessment is presented in Appendix E of the Statement of Basis.
Compliance with standards was only demonstrated for the current equipment layout at the site.	Compliance with standards is not assured if locations of pollutant emitting equipment at the site are substantially changed.

2.0 Background Information

2.1 Applicable Air Quality Impact Limits and Modeling Requirements

This section identifies applicable ambient air quality limits and analyses used to demonstrate compliance.

2.1.1 Area Classification

The Valley Paving facility will only be located in areas designated as attainment or unclassifiable for all criteria pollutants. The McCall area is an attainment or unclassifiable area for sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), and particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}).

2.1.2 *Significant and Full NAAQS Impact Analyses*

If estimated maximum pollutant impacts to ambient air from the emissions sources associated with the proposed modification exceed the significant contribution levels (SCLs) of Idaho Air Rules Section 006.102, then a full impact analysis is necessary to demonstrate compliance with National Ambient Air Quality Standards (NAAQS) and Idaho Air Rules Section 203.02. A full NAAQS impact analysis for attainment area pollutants involves adding ambient impacts from facility-wide emissions, and emissions from any nearby co-contributing sources, to DEQ-approved background concentration values that are appropriate for the criteria pollutant/averaging-time at the facility location and the area of significant impact. The resulting maximum pollutant concentrations in ambient air are then compared to the NAAQS listed in Table 2. Table 2 also lists SCLs and specifies the modeled value that must be used for comparison to the NAAQS.

Table 2. APPLICABLE REGULATORY LIMITS

Pollutant	Averaging Period	Significant Contribution Levels[a] ($\mu g/m^3$)[b]	Regulatory Limit[c] ($\mu g/m^3$)	Modeled Value Used[d]
PM_{10}[e]	Annual[f]	1.0	50[g]	Maximum 1st highest[h]
	24-hour	5.0	150[i]	Maximum 6th highest[j]
$PM_{2.5}$	Annual	Not established	15	Use PM_{10} as surrogate
	24-hour	Not established	35	Use PM_{10} as surrogate
Carbon monoxide (CO)	8-hour	500	10,000[k]	Maximum 2nd highest[h]
	1-hour	2,000	40,000[k]	Maximum 2nd highest[h]
Sulfur Dioxide (SO_2)	Annual	1.0	80[g]	Maximum 1st highest[h]
	24-hour	5	365[k]	Maximum 2nd highest[h]
	3-hour	25	1,300[k]	Maximum 2nd highest[h]
Nitrogen Dioxide (NO_2)	Annual	1.0	100[g]	Maximum 1st highest[h]
Lead (Pb)	Quarterly	NA	1.5[i]	Maximum 1st highest[h]

[a]Idaho Air Rules Section 006.102
[b]Micrograms per cubic meter
[c]Idaho Air Rules Section 577 for criteria pollutants
[d]The maximum 1st highest modeled value is always used for significant impact analysis
[e]Particulate matter with an aerodynamic diameter less than or equal to a nominal ten micrometers
[f]The annual PM_{10} standard was revoked in 2006. The standard is still listed because compliance with the annual $PM_{2.5}$ standard is demonstrated by a PM_{10} analysis that demonstrates compliance with the revoked PM_{10} standard.
[g]Never expected to be exceeded in any calendar year
[h]Concentration at any modeled receptor
[i]Never expected to be exceeded more than once in any calendar year
[j]Concentration at any modeled receptor when using five years of meteorological data
[k]Not to be exceeded more than once per year

New source review requirements for assuring compliance with $PM_{2.5}$ standards have not yet been developed. EPA has asserted through a policy memorandum that compliance with $PM_{2.5}$ standards will be assured through an air quality analysis for the corresponding PM_{10} standard. Although the PM_{10} annual standard was revoked in 2006, compliance with the revoked PM_{10} annual standard must be demonstrated as a surrogate to the annual $PM_{2.5}$ standard.

2.1.3 *Toxic Air Pollutant Analyses*

Emissions of toxic substances are generally addressed by Idaho Air Rules Section 161:

> *Any contaminant which is by its nature toxic to human or animal life or vegetation shall not be emitted in such quantities or concentrations as to alone, or in combination with other contaminants, injure or unreasonably affect human or animal life or vegetation.*

Permit requirements for toxic air pollutants from new or modified sources are specifically addressed by Idaho Air Rules Section 203.03 and require the applicant to demonstrate to the satisfaction of DEQ the following:

> *Using the methods provided in Section 210, the emissions of toxic air pollutants from the stationary source or modification would not injure or unreasonably affect human or animal life or vegetation as required by Section 161. Compliance with all applicable toxic air pollutant carcinogenic increments and toxic air pollutant non-carcinogenic increments will also demonstrate preconstruction compliance with Section 161 with regards to the pollutants listed in Sections 585 and 586.*

Per Section 210, if the emissions increase associated with a new source or modification exceeds screening emission levels (ELs) of Idaho Air Rules Section 585 or 586, then the ambient impact of the emissions increase must be estimated. If ambient impacts are less than applicable Acceptable Ambient Concentrations (AACs) for non-carcinogens of Idaho Air Rules Section 585 and Acceptable Ambient Concentrations for Carcinogens (AACCs) of Idaho Air Rules Section 586, then preconstruction compliance with TAP requirements has been demonstrated.

Concerns of potential exposures to toxic substances were expressed during the permit application review period. DEQ permitting staff then directed a preliminary facility-wide air quality assessment of toxic substances to evaluate potential impacts. This assessment was conducted under DEQ's authority to evaluate compliance with Idaho Air Rules Section 161. A risk assessment for modeled concentrations was also conducted by DEQ and is presented in Appendix E of the Statement of Basis.

2.2 Background Concentrations

Background concentrations are used in the full NAAQS impact analyses to account for impacts from sources not explicitly modeled. Background concentrations were revised for all areas of Idaho by DEQ in March 2003[1]. Background concentrations in areas where no monitoring data are available were based on monitoring data from areas with similar population density, meteorology, and emissions sources. Default rural/agricultural PM_{10} background concentrations of 73 $\mu g/m^3$ for the 24-hour averaging period and 26 $\mu g/m^3$ for the annual averaging period were used because HMA plants are typically located outside of urban areas. The area in McCall where the plant is currently located is more representative of rural/agriculatural areas than urban areas for the purpose of determining background concentrations.

3.0 Modeling Impact Assessment

3.1 Modeling Methodology

This section describes the modeling methods used by the applicant and DEQ to demonstrate compliance with applicable air quality standards. Attachment A provides more details of emissions calculations and modeling parameters used in the analyses.

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1 Hardy, Rick and Schilling, Kevin. *Background Concentrations for Use in New Source Review Dispersion Modeling*. Memorandum to Mary Anderson, March 14, 2003.

3.1.1 Overview of Analyses

Several air quality analyses were conducted for this facility; each at an increased level of refinement and improved accuracy.

These analyses were as follows:

1. The submitted analyses, focusing on the total emissions from the HMA plant. These analyses used screening-level methods and data; and they are more representative of typical portable HMA plants, with moderate conservatism incorporated into assumptions used.

2. DEQ moderately refined analyses using the dispersion model ISCST3, focusing both on the proposed modification and the entire facility, including the concrete batch plant and rock crushing plant that are located at the site. These analyses used a more refined dispersion model and incorporated more site-specific parameters.

3. DEQ highly refined analyses using the dispersion model AERMOD, primarily focusing on impacts from the entire facility. These analyses also accounted for a more thorough assessment of impacts to ambient air from toxic substances potentially emitted from the site, including additive risks from carcinogenic compounds.

Attachment A to this memorandum provides calculation sheets that were used to develop modeled emissions rates and model input parameters.

<u>Submitted Analyses</u>

DEQ's streamlined dispersion modeling method for portable HMA plants was used initially by Bison for this application. This method is described in a March 23, 2006 DEQ memorandum, and is most appropriate for portable HMA plants because of the continual change in the equipment configuration and site-to-site variability. Emissions sources were located within a 20-meter by 20-meter area, and the ambient air boundary was assumed to be a 100-meter radius from the center of the emissions source area. Modeling for the asphalt loadout, silo loading, and miscellaneous material handling were based on a typical plant layout, a processing rate of 300 tons per hour, and an annual operation rate of 1,000 hours per year. Results were then used to generate the dispersion factors listed in the March 2006 memorandum, which are a function of processing and operational rates. Impacts associated with operational rates of the Valley Paving facility were then calculated by multiplying the dispersion factors by the permit allowable operational rates. Impacts from the main dryer stack were estimated using the screening-level atmospheric dispersion model SCREEN3. Total impacts were calculated by adding the impacts of all individual sources together.

SCREEN3 only generates maximum 1-hour pollutant concentrations. To evaluate concentrations for other averaging periods the following persistence factors were used:

- 1-hour to 24-hour factor = 0.4
- 1-hour to annual factor = 0.08 (a factor of 0.125 is required for carcinogenic TAPs)

Bison did not model the emissions increases for significant impact analyses, but elected to conduct full NAAQS impact analyses, modeling total proposed allowable emissions from the HMA. However, impacts from the cement batch plant and the rock crusher at the facility were not included, presumably because the DEQ HMA generic modeling analysis forms did not address the scenario of other types of facilities being located at a single site or nearby. Also, the submitted analysis did not account for condensable particulate emitted from the drum dryer.

DEQ ISCST3 Analyses

DEQ performed moderately refined analyses of the HMA plant using the model ISCST3, considering facility-specific parameters and refined full-impact analyses to evaluate impacts from the HMA plant when combined with impacts of the ready-mix concrete batch plant and the rock crushing plant, also located on the site. DEQ's moderately refined ISCST3 analyses used actual equipment locations to establish emissions points, as shown on a submitted facility plot plan. Table 3 provides a summary of the modeling parameters used in the DEQ ISCST3 analyses that were submitted for the public comment period starting in November 2006. Detailed descriptions of methods, data, and results from the ISCST3 analyses were provided in the modeling memorandum issued for the November 2006 public comment period. These descriptions will not be repeated in this memorandum because they have been replaced by DEQ's refined analyses as described below.

Table 3. MODERATELY REFINED ISCST3 MODELING PARAMETERS

Parameter	Description/Values	Documentation/Addition Description
Model	ISCST3-PRIME	ISCST3 with the PRIME downwash algorithm, version 04269
Meteorological data	1987-1991	Boise surface and upper air data, rotated for McCall conditions
Terrain	Flat	Flat terrain used since maximum impacts are very near the facility
Building downwash	Considered	The building profile input program (BPIP) was used
Receptor Grid	Grid 1	25-meter spacing along boundary out to 150 meters
	Grid 2	50-meter spacing out to 500 meters
	Grid 3	100-meter spacing out to 2,000 meters

DEQ Refined AERMOD Analyses and Risk Assessment

DEQ received numerous comments regarding the impacts of facility-wide emissions of toxic substances during the initial public comment period for the proposed permit, running from early November, 2006, to mid January, 2007. DEQ determined more refined assessment of toxic substances was warranted under Idaho Air Rules Section 161 because of the close proximity of potentially exposed public to the Valley Paving facility and the modeled concentrations of toxic substances obtained from the DEQ ISCST3 analyses. DEQ air quality staff conducted the refined analyses of toxic substances, and details of dispersion modeling for the refined analyses are described in this memorandum. The refined analyses of toxic substances included the following:

- Account for control efficiency of the wet scrubber on particulate air toxics.
- Use of the dispersion model AERMOD rather than ISCST3. AERMOD is the replacement model for ISCST3 and must be used for air quality analyses submitted after November 2006.
- Consideration of effects caused by terrain.
- Refinement of adjustments to meteorological data (degree to which wind fields are adjusted to account for McCall meteorology).
- Accounting for multiple pathway exposures from carcinogenic toxic substances emitted from the Valley Paving facility (dermal and ingestion pathways as well as inhalation).
- Consideration of additive risks across carcinogenic toxic substances emitted that measurably contribute to the total risk.
- Evaluation of multiple meteorological data sets to account for questionable representativeness of Boise data to the McCall area.

The air quality impact analyses for criteria pollutants were also refined to include the following:

- Revision of PM_{10} emissions to account for condensable particulate and control be the scrubber.
- Use of AERMOD rather than ISCST3.
- Consideration of effects caused by terrain.

Table 4 lists a summary of modeling parameters used in the DEQ refined analyses.

Table 4. REFINED MODELING PARAMETERS		
Parameter	**Description/Values**	**Documentation/Addition Description**
Model	AERMOD	AERMOD with the PRIME downwash algorithm, version 07026
Meteorological data	1988-1992	Boise, Idaho surface and upper air data, with wind direction fields rotated for McCall conditions
	1987-1991	Spokane, Washington, surface and upper air data, with wind direction fields rotated for McCall conditions.
Terrain	Considered	Receptor, building, and emissions source elevations were determined using Digital Elevation Model (DEM) files
Building downwash	Considered	The building profile input program (BPIP) was used
Receptor Grid	Grid 1	25-meter spacing along the property boundary out to 200 meters
	Grid 2	100-meter spacing out to 1,500 meters
	Grid 3	500-meter spacing out to 4,000 meters

3.1.2 Modeling protocol and Methodology

The initially submitted air impact analyses were conducted by Bison. DEQ was contacted prior to the application submittal, and DEQ recommended use of the streamlined approach. Modeling was conducted using methods and data presented in the March 23, 2006 DEQ memorandum presenting the streamlined modeling methods for HMAs and the *State of Idaho Air Quality Modeling Guideline*. Subsequent analyses were conducted by DEQ staff.

3.1.3 Model Selection

ISCST3 with the PRIME downwash algorithm was used for DEQ's moderately refined modeling analyses that were presented for the November 2006 public comment period. ISCST3 uses actual monitored meteorological data and uses actual locations of emissions units in the evaluation of air pollutant impacts.

Idaho Air Rules Section 202.02 require that estimates of ambient concentrations be based on air quality models specified in 40 CFR 51, Appendix W (Guideline on Air Quality Models). The refined, steady state, multiple source, Gaussian dispersion model AERMOD was promulgated as the replacement model for ISCST3 in December 2005. EPA provided a 1-year transition period during which either ISCST3 or AERMOD could be used at the discretion of the permitting agency. AERMOD must be used for all air impact analyses, performed in support of air quality permitting, conducted after November 2006.

AERMOD retains the single straight line trajectory of ISCST3, but includes more advanced algorithms to assess turbulent mixing processes in the planetary boundary layer for both convective and stable stratified layers.

AERMOD offers the following improvements over ISCST3:

- Improved dispersion in the convective boundary layer and the stable boundary layer
- Improved plume rise and buoyancy calculations

- Improved treatment of terrain affects on dispersion
- New vertical profiles of wind, turbulence, and temperature

AERMOD was used in DEQ's refined analyses for PM_{10} and toxic substances.

3.1.4 Meteorological Data

Surface and upper air meteorological data monitored from Boise, Idaho, were used for the refined modeling analyses. Boise National Weather Service data were used because data from McCall were not suitable as input for running AERMOD. To account for differences between Boise and McCall for the prevailing wind direction, the Boise wind direction values were rotated by 57 degrees. The degree of rotation was determined by comparing annual windroses for Boise and McCall.

Use of representative meteorological data is of greater concern when using AERMOD than when using ISCST3. This is because AERMOD uses site-specific surface characteristics to properly account for turbulence. Boise meteorological data is of questionable representativeness for the McCall area, even with the wind direction adjustments. To account for this uncertainty the following measures were taken:

- Use the highest 1st high modeled concentration to evaluate compliance with the 24-hour PM_{10} standard, rather than the highest 6th high modeled concentration typically used when modeling a five-year meteorological data set to demonstrate that the standard will not be exceeded more than once per year on average over a three year period.

- Model the facility using meteorological data collected from Spokane, Washington, as well as data collected from Boise, Idaho. Spokane wind direction data were rotated by -45 degrees to account for predominant wind direction differences between Spokane and McCall.

3.1.5 Terrain Effects

Terrain effects on dispersion were not considered in the initial screening or moderately refined analyses. Because maximum impacts from the near ground-level sources at the facility are within several hundred meters, terrain effects on maximum modeled impacts are minimal. Elevation differences between the base of emissions sources and offsite receptors were considered in the more refined analyses using AERMOD.

3.1.6 Facility Layout

The facility plot plan submitted to DEQ was used to establish the general location of the HMA plant, the ready-mix concrete batch plant, and the rock crusher.

3.1.7 Building Downwash

No buildings of sufficient size to cause plume downwash were identified for the Valley Paving HMA plant. A 10-meter square building, 10 meters tall, was used as a representation of structures associated with the ready-mix cement batch plant.

3.1.8 Ambient Air Boundary

The facility property boundary, as identified on a submitted plot plan, was used as the ambient air boundary for the DEQ refined analyses. DEQ assumed reasonable measures would be taken to ensure the general public is excluded from access to the property. The public roadway transecting the facility is considered ambient air for criteria pollutants and non-carcinogenic TAPs. It is not considered as ambient air for carcinogenic TAPs (as per Idaho Air Rules Section 210.03.b) because long-term exposures to the public cannot reasonably occur at such a location. The public roadway transecting the facility was also excluded from ambient air receptor locations for the refined facility-wide air toxics analyses described in Section 3.1.1 and 3.5.

3.1.9 Receptor Network

Table 4 describes the receptor grid used in DEQ's refined analyses. The receptor grid met the minimum recommendations specified in the *State of Idaho Air Quality Modeling Guideline*. DEQ determined the receptor grid was adequate to reasonably resolve maximum modeled concentrations.

3.2 Emission Rates

Emissions rates, for all pollutants except PM_{10}, used in the generic HMA plant dispersion modeling analyses were based on emissions factors from EPA's AP-42 Section 11.1 (March 2004), *Hot Mix Asphalt Plants*. Emissions increases from the proposed modification were based on the difference between current permit allowables and proposed maximum emissions, considering the allowed change in fuels. The proposed modification will increase short-term processing rates from 200 tons per hour to 300 tons per hour, but will not increase annual production from the current allowable of 280,000 tons per year.

3.2.1 Criteria Pollutant Emissions Rates

Bison calculated the emissions increase for the HMA dryer that will be attributable to the proposed modification, but did not conduct significant impact analyses. They elected to used total emissions from the dryer (existing allowable plus the increase resulting from the modification) for full NAAQS impact analyses of criteria pollutants from the HMA dryer. Bison did not provide emissions calculations for asphalt loadout, silo filling, or material conveying activities; however, they accounted for impacts from these sources through use of methods presented in DEQ's generic HMA impact assessment forms. Facility-wide allowable emissions for the HMA plant were used for the full impact analyses, based on 300 tons per hour and 280,000 tons per year production. Bison's analyses did not account for impacts from the existing ready-mix concrete batch plant or the rock crushing plant that are typically located on the facility's property.

Submitted PM_{10} emissions estimates from the drum dryer were based on compliance with the grain loading standard combined with the estimated flow and an estimated PM_{10} fraction of total particulate. This method substantially underestimates PM_{10} because condensable particulate is not considered. DEQ revised potential PM_{10} emissions estimates using the emissions factors in EPA's AP-42, Chapter 11.1 *Hot Mix Asphalt Plants*.

Table 5 shows the emissions increases at the HMA plant that are associated with this modification, as calculated by DEQ. There is no listed increase for SO_2, even though there is a short term throughput increase and the SO_2 emissions factor for using waste oil is greater than that for using No. 2 oil. The existing permit allowed SO_2 emissions at 29.2 lb/hr, well above the 17.4 lb/hr maximum emissions rate estimated for burning waste oil. Because the permit allowable rate will not be increased, 0.0 lb/hr is the appropriate emissions increase to evaluate the need for a modeling analysis and/or a full NAAQS impact analysis. Annual NOx emissions did not actually increase as a result of changing fuels. Because previous allowable NOx emissions are less than currently-estimated NOx emissions, an emissions increase is calculated when comparing estimated emissions and current permit-allowable emissions. Bison's estimated emissions increase is more than values listed in Table 5 because those estimates were based on 300 ton/hr processing for 1,400 hours, rather than the allowable 280,000 tons/yr HMA production rate.

Table 5. INCREASE IN EMISSIONS RATES USED FOR SIGNIFICANT IMPACT MODELING

Emissions Point	Description	Emissions Rates (lb/hr)				
		PM_{10}[a] 24-Hour	PM_{10}[a] Annual	SO_2[b]	CO[c]	NOx[d]
ASPSTAK	HMA main stack	6.2 (0.0[e])	0.5780 (0.0[e])	0.0	31.4	0.616[f] (1.51[e,f])
LOAD	HMA asphalt loadout	0.0522	0.0	0.0	0.135	0.0
SILO	HMA silo filling	0.0586	0.0	0.0	0.118	0.0
CONVEY	HMA converyors handling aggregate	0.0276	0.0	0.0	0.0	0.0

[a] Particulate matter with an aerodynamic diameter less than or equal to a nominal ten micrometers
[b] Sulfur dioxide
[c] Carbon monoxide
[d] Nitrogen dioxide
[e] Value submitted in application
[f] Annualized emissions (annual emissions divided by 8760 hr/yr)

Emissions increases of PM_{10}, CO, and NOx exceeded modeling thresholds listed in DEQ's *State of Idaho Air Quality Modeling Guideline*. Increases of CO, NOx, and annual PM_{10} are below recently developed DEQ discretionary modeling thresholds. Use of these discretionary thresholds are approved on a case-by-case basis considering the characteristics of the emissions sources, such as location, stack height, stack gas temperature, stack gas flow rate, and the magnitude of that pollutant's emissions from other sources at the facility. Since the proposed increase in CO and NOx emissions were below these thresholds and Bison conducted a full NAAQS impact analysis for these pollutants, DEQ dispersion modeling staff did not conduct independent modeling analyses for these pollutants. DEQ conducted a refined PM_{10} annual full NAAQS impact analysis because of the suspected underestimation of emissions used in the submitted analyses and the presence of other PM_{10} emissions sources nearby.

DEQ's facility-wide analyses included impacts from the ready-mix concrete batch plant and the rock crushing plant that are typically located at the Valley Paving site. The concrete batch plant is operated by Clearwater Concrete, Inc., and emissions from the storage silo were based on permit allowable rates. Emissions from other fugitive sources at the plant were based on allowable throughput and emissions factors from EPA's AP-42 Chapter 13.2.4. Emissions controls from the cement plant truck loadout source were not mentioned or required by the existing permit. Recent photographs of the plant indicate emissions are controlled by a curtain and emissions capture system. An estimated emissions control of 95 percent was applied to uncontrolled emissions estimates for use in the dispersion model.

Emissions from the handling of aggregate and sand for the cement plant are a function of material moisture content. Because the material moisture content will vary with season, a separate emissions rate for late fall (October) through early spring (April) was developed and used for the 24-hour PM_{10} analyses. Emissions from these sources also vary with windspeed. A base emissions rate was calculated for a 10 mile/hour (mph) wind, and adjustment factors were made for windspeed categories of 1.7 mph, 5.2 mph, 9.2 mph, 15.0 mph, 21.3 mph, and 27.7 mph. The adjustment factors were entered in the model to be used with the appropriate wind speed for the particular hour modeled.

Table 6 lists emissions rates used in the facility-wide NAAQS modeling analyses. Facility-wide impact analyses were only required for PM_{10}. The impacts from the proposed modification for other criteria pollutants were below discretionary threshold values used to identify the need to conduct a dispersion modeling analysis to evaluate impacts. After considering total SO_2, CO, and NOx emissions at the facility, other potential sources of these pollutants in the surrounding area, and the analyses submitted by the applicant, DEQ determined the submitted analyses adequately demonstrated compliance with the SO_2, CO, and NO_2 NAAQS.

Table 6. FACILITY-WIDE EMISSIONS RATES USED FOR MODELING

Emissions Point	Description	PM_{10}[a] Emissions Rates (lb/hr[b])	
		Short Term	Long Term
ASPSTAK	HMA main stack	8.0	0.85
LOAD	HMA asphalt loadout	0.157	0.0167
SILO	HMA silo filling	0.176	0.0187
CONVEY	HMA converyors handling aggregate	0.0828	0.00882
CSILO	Cement plant storage silo	0.00776	0.00776
CTLOAD	Cement plant truck loadout	0.313	0.313
WEIGHHP	Cement plant weigh hopper loading	0.316	0.316
CAGGSAND	Cement plant sand/aggregate handling	0.600 (0.297[c])	0.600 (0.297[c])
CAGSTOR	Cement plant sand/aggregate to elevated storage	0.300 (0.149[c])	0.300 (0.149[c])
CRTRUK	Crusher aggregate truck unloading	0.0024	0.0024
CRUSHER	Crusher aggregate conveyors	0.0828	0.0828
CRSCREEN	Crusher primary screen	0.222	0.222
CRTIRTSC	Crusher 3° crusher + screen	0.384	0.384

a. Particulate matter with an aerodynamic diameter less than or equal to a nominal ten micrometers
b. Pounds per hour
c. Emissions rate for wet conditions of late fall through early spring

3.2.2 TAP Emissions Rates

Table 7 lists applicable TAP emissions increases associated with the HMA plant modification. There is no increase in carcinogenic TAP emissions for asphalt plant loadout and silo filling because the modification will not increase the annual asphalt production rate and TAP emissions factors for these sources are independent of fuel type used in the dryer. The pound/hour value required for comparison to the EL is an annualized emissions rate for carcinogenic TAPs rather than the maximum short-term pound/hour rate. Emissions of TAPs not listed in Table 7 were below applicable screening emissions levels (ELs) and modeling was not required.

Table 7. MODELED TAP EMISSIONS RATES

Pollutant	Averaging Period	Source-Specific Emissions Rates[a] (lb/hr)[b]				
		ASPSTAK	LOAD	SILO	TOTAL	EL
Hydrogen Chloride (HCl)	24-hour	0.0630	0.0	0.0	6.3E-2	0.05
Propionaldehyde	24-hour	0.0390	0.0	0.0	3.9E-2	0.0287
Quinone	24-hour	0.0480	0.0	0.0	4.8E-2	0.027
Acetaldehyde	annual	0.04155	0.0	0.0	4.16E-2	0.00300

a. Values for TAPs with an annual averaging period are annual values divided by 8760 hour/year
b. Pounds per hour

DEQ also conducted facility-wide air quality analyses for air emissions of toxic substances as described in Section 2.1.3 of this memorandum. Table 8 provides total emissions rates of toxic substances for sources at the site.

Table 8. FACILITY-WIDE TOXIC SUBSTANCE EMISSIONS						
TAP	Averaging Period	Emissions Rate[a] (lbs/hr[b])				
		ASPSTAK	LOAD	SILO	CSILO	CTLOAD
Dioxins and furans[c]	Annual	1.22E-10	ND	ND	ND	ND
Polycyclic organic matter	Annual	1.75E-5	1.47E-5	2.16E-5	ND	ND
Acetaldehyde	Annual	4.16E-2	ND	ND	ND	ND
Benzene	Annual	1.25E-2	6.91E-5	1.25E-4	ND	ND
Formaldehyde	Annual	9.91E-2	1.17E-4	2.69E-3	ND	ND
Arsenic	Annual	1.25E-5	ND	ND	9.56E-8	2.61E-5
Beryllium	Annual	ND	ND	ND	1.10E-8	2.34E-6
Cadmium	Annual	4.03E-5	ND	ND	1.10E-8	2.04E-7
Chromium 6+	Annual	1.89E-5	ND	ND	1.31E-7	1.85E-5
Nickel	Annual	1.25E-2	ND	ND	9.42E-7	1.08E-4
HCl	24-hour	6.30E-2	ND	ND	ND	ND
Propionaldehyde	24-hour	3.90E-2	ND	ND	ND	ND
Quinone	24-hour	4.80E-2	ND	ND	ND	ND

[a] Values for TAPs with an annual averaging period are annual emissions values divided by 8760 hour/year. ND indicates no data.
[b] Pounds per hour
[c] TCDD equivalent

3.3 *Emission Release Parameters*

Table 9 provides emissions release parameters for the DEQ refined analyses including stack height, stack diameter, exhaust temperature, and exhaust velocity. Attachment A provides more details on the calculation of initial horizontal and vertical dispersion coefficients for volume sources.

Table 9. EMISSIONS AND STACK PARAMETERS					
Release Point /Location	Source Type	Stack Height (m)[a]	Modeled Diameter (m)	Stack Gas Temp. (K)[b]	Stack Gas Flow Velocity (m/sec)[c]
ASPSTAK	Point	7.3	1.1	333	14.6
CSILO	Point	10	1	Ambient	0.34
Volume Sources					
Release Point /Location	Source Type	Release Height (m)	Initial Horizontal Dispersion Coefficient σ_{y0} (m)	Initial Vertical Dispersion Coefficient σ_{z0} (m)	
LOAD	Volume	5	0.70	4.65	
SILO	Volume	7.5	0.70	4.65	
CONVEY	Volume	2.5	7.0	1.2	
CAGSAND	Volume	3.0	11.6	1.4	
CAGSTOR	Volume	5.0	1.16	4.65	
CTLOAD	Volume	5.0	2.33	4.65	
CWEIGHHP	Volume	5.0	2.33	4.65	
CRUSHER	Volume	5.0	6.98	1.16	
CRTRUK	Volume	2.0	1.16	0.93	
CRSCREEN	Volume	5.0	1.16	1.16	
CRTIRTSC	Volume	5.0	2.33	1.16	

[a] Meters
[b] Kelvin
[c] Meters per second

3.4 Results for Significant and Full Impact Analyses

Results from DEQ's significant impact analyses are shown in Table 10. PM_{10} significant impact analysis modeling for the annual averaging period was not required because annual allowable PM_{10} emissions increases are below recently revised discretionary modeling thresholds, and the emissions release characteristics of the source (stack height, flow rate, temperature, and distance to ambient air boundary) are such that the revised thresholds are appropriate.

A full NAAQS impact analysis was required for 24-hour PM_{10} because results from the significant impact analysis exceeded SILs. Although a significant impact analysis for annual averaged PM_{10} was not required, DEQ determined a full impact analysis was appropriate because of the presence of nearby co-contributing PM_{10} sources.

Table 10. SIGNIFICANT IMPACT ANALYSES

Pollutant	Averaging Period	Maximum Modeled Concentration ($\mu g/m^3$)[a]	Significant Impact Level ($\mu g/m^3$)	Full Impact Analysis Required
PM_{10}[b]	24-hour	51.1	5.0	Yes

[a] Micrograms per cubic meter
[b] Particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers

The PM_{10} full impact analyses included total impacts from the HMA plant as well as impacts from the concrete batch plant and the rock crushing plant at the site. Initial model runs, using conservative assumptions, did not satisfactorily demonstrate compliance with the 24-hour PM_{10} standard when combined with a default background concentration of 73 $\mu g/m^3$. The primary contributor to the high modeled concentrations was emissions from the ready-mix concrete batch plant. The PM_{10} modeling analysis was then refined by separating operations into two scenarios. The dry material scenario was run for the late spring through early fall months of May through September. Material handling emissions for this period were calculated using AP-42 default material moisture contents (1.77% for aggregate and 4.17% for sand). Emissions for the moist material scenario, for October through April, were calculated using an aggregate material moisture content of two times the default value. The modeling scenario for October through April did not account for reduced daily production that is typical for this period. Consequently, results for this period could still overestimate impacts as compared to those from actual production rates and site conditions.

DEQ used the maximum of 1st highest modeled concentrations as the NAAQS compliance design value, rather than the maximum of 6th highest modeled concentrations typically allowed for 24-hour averaged PM_{10}. This approach was used to account for greater uncertainty associated with the use of meteorological data that may not be highly representative of conditions at McCall. DEQ also assessed 24-hour PM_{10} impacts for the moist material scenario using meteorological data obtained from Spokane, Washington. This was done to provide information on the sensitivity of model results to specific meteorological data sets.

Table 11 shows results for the full impact analyses, and Figure 1 shows PM_{10} 24-hour averaged concentration contours for the wet season scenario, excluding concentrations within the road transecting the facility. Modeled 24-hour concentrations at all ambient air receptors are below the 150 $\mu g/m^3$ standard, except for a small number of receptors along the road transecting the Valley Paving facility. Review of modeling results indicated that modeled exceedances along the roadway only occurred during the October through April period. Actual impacts during this period are likely to be substantially less because of decreased production and increased moisture content of materials handled. Although effects of increased moisture were accounted for in emissions calculations for general aggregate/sand handling at the ready mix concrete plant, it was not considered for emissions from the concrete plant weigh hopper loading, aggregate handling for the HMA plant (beyond the assumed control by wet suppression), or emissions from the on-site crusher. Also, emissions from fugitive dust sources are highly uncertain and highly variable.

Table 11. RESULTS FOR FULL IMPACT ANALYSES

Pollutant	Averaging Period	Maximum Modeled Concentration[a] (μg/m³)[b]	Background Concentration (μg/m³)	Total Ambient Impact (μg/m³)	NAAQS[c] (μg/m³)	Percent of NAAQS
PM_{10}[d] dry season, excluding road	24-hour	60.1 (54.8[e])	73	133.1 (127.8[e])	150	89 (85)
PM_{10} dry season, road segment	24-hour	66.8 (51.2[e])	73	139.8 (124.2[e])	150	93 (83)
PM_{10} wet season, excluding road	24-hour	72.2 (75.2[e])	73	145.2 (148.2[e])	150	97 (98.8)
PM_{10} wet season, road segment	24-hour	153.3 92.3[f] (113.2[e])(50.0[e,f])	73	226.3 165.3[f] (186.2[e]) (123.0[e,f])	150	151 110 124 82
PM_{10} wet season, road segment, non-fugitives[g]	24-hour	94.5 66.4[h] (80.0[e])(53.0[e,h])	73	167.5 139.4[h] (153.0[e])(126.0[e,h])	150	112 93 (102)(84)
PM_{10} wet season, road segment, HMA only	24-hour	64.5 (55.1[e])	73	137.5 (128.1[e])	150	92 (85)
PM_{10} wet season, road segment, cement plant only	24-hour	102.6 (87.5[d,e])	73	175.6 (160.5[e])	150	117 (107)
PM_{10} excluding road	Annual	9.0	26	35.0	50	70
PM_{10} road segment	Annual	28.8	26	54.8	50	110
CO	1-hour	948[i]	3,600	4,548	40,000	11
	8-hour	385[i]	2,300	2,685	10,000	27
SO_2	3-hour	427[d] (256[i])	34	461 (290[i])	1,300	35 (22[i])
	24-hour	225[d] (114[i])	26	251 (140[i])	365	69 (38[i])
	Annual	23[i]	8	31	80	39
NO_2	Annual	7.5[i]	17	24.5	100	25

[a] The maximum of 1st highest modeled concentrations are used unless otherwise noted
[b] Micrograms per cubic meter
[c] National ambient air quality standards
[d] Particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers
[e] Spokane meteorological data
[f] Maximum 6th highest modeled concentration
[g] Includes emissions from asphalt plant stack, asphalt loadout, asphalt silo filling, cement silo filling, cement plant truck loadout, cement plant weigh hopper loading – excludes material handling fugitive emissions (material transfer points)
[h] Maximum 2nd highest modeled concentration
[i] Value obtained by Bison and submitted with application

Modeling results for the wet season scenario using meteorological data from Spokane, Washington, were very similar to results obtained for Boise meteorological data, as shown in Table 11. This suggests model results are rather insensitive to the specific meteorological data set used, provided the wind direction fields are adjusted to match the predominant wind direction for the area. The apparent insensitivity to the specific meteorological data used likely results from the nature of the emissions sources modeled. Near ground level fugitive sources and emissions from relatively short stacks cause maximum concentrations to be located very near to the facility boundary. Site-to-site differences in thermal turbulence characteristics, considerably affecting dispersion from tall stacks at distant downwind locations, will not substantially change dispersion from surface emissions sources or relatively short stacks.

Emissions from the ready mix concrete plant are the primary contributor to modeled exceedances of the PM_{10} 24-hour standard along the roadway, as shown in Table 11. It is possible that emissions estimates for truck loading and weigh hopper loading are over-estimated because the level of emissions control used was not adequately considered. Because the permit issued to the ready mix plant does not address either of those emissions points, there is no enforceable requirement to control these sources beyond a "reasonable" level of control needed to meet fugitive dust requirements of Idaho Air Rules Section 651. DEQ determined the level of emissions control for sources of the ready mix plant are consistent with what would be needed to comply with the fugitive dust requirements. It is also unlikely that the ready mix concrete plant will frequently operate at maximum allowable throughput for 24 hours per day during the winter season, as was assumed for evaluating air quality impacts. The professional judgment of DEQ air modeling staff is that aggressive control of potential fugitive dust sources, combined with reasonably anticipated reduced production during the period of October through April, will reasonably assure compliance with the 24-hour PM_{10} NAAQS at all ambient air locations.

3.5 Results for TAPs Analyses

Compliance with TAP increments as required by Idaho Air Rules Section 210 were demonstrated by modeling uncontrolled TAP emissions increases (those TAPs with emissions exceeding the ELs) resulting from modifications made to the HMA plant. Table 12 summarizes the ambient TAP analyses. TAP impacts from increased emissions associated with the proposed modification are all below applicable AACs/AACCs, thereby demonstrating compliance with Idaho Air Rules Section 210.

Table 12. RESULTS OF TAP ANALYSES

TAP	Averaging Period	Maximum Modeled Concentration ($\mu g/m^3$)[a]	AAC/AACC[b] ($\mu g/m^3$)	Percent of AAC/AACC
Hydrochloric acid	24-hour	0.49	375	0.13
Propionaldehyde	24-hour	0.30	21.5	1.4
Quinine	24-hour	0.37	20	1.9
Acetaldehyde	Annual	0.039	0.45	8.7

[a]Micrograms per cubic meter
[b]Acceptable Ambient Concentration or Acceptable Ambient Concentration for a Carcinogen

Facility-wide modeling results of carcinogenic toxic substances, providing maximum offsite concentrations, are given in Table 13. The concentrations listed do not all occur at the same receptor. The corresponding AAC or AACC is shown for each air toxic as a reference only. Compliance with the AACs and AACCs are not required for facility-wide emissions as explained in Section 2.1.3 of this memorandum; they are increment standards and are only applicable on a project-by-project basis. Facility-wide impacts are only relevant to Idaho Air Rules Section 161, which states, "Any contaminant which is by its nature toxic to human or animal life or vegetation shall not be emitted in such quantities or concentrations as to alone, or in combination with other contaminants, injure or unreasonably affect human or animal life or vegetation."

Results from facility-wide air modeling of carcinogenic toxic substances were used to conduct a more refined risk assessment. The following procedures were used for the refined risk assessment:

1. Modeled long-term concentrations of each carcinogenic toxic substance at all receptor locations were converted to total risk numbers in terms of lifetime cancer risk, based on continual exposure to airborne concentrations.

2. Total risks from the air pathway were calculated for each receptor by summing across concentrations of all toxic substances, and the following was identified:

- Location of maximum offsite risk
- Location of maximum risk at a residential location
- Location of maximum risk at location of a neighboring business.

3. Long-term concentrations of specific carcinogenic toxic substances at the locations identified above were determined from the modeling results, and concentrations were forwarded to DEQ staff responsible for conducting a refined risk assessment.

Table 13. RESULTS OF FACILITY-WIDE TOXIC SUBSTANCE ANALYSES

TAP	Averaging Period	Maximum Modeled Concentration ($\mu g/m^3$)[a]	AAC/AACC ($\mu g/m^3$)	Percent of AAC/AACC
Dioxins and furans	Annual	1.1E-10	2.2E-8	0.5
Polycyclic organic matter	Annual	5.18E-4	3.0E-4	173
Acetaldehyde	Annual	3.88E-2	4.5E-1	9
Benzene	Annual	1.40E-2	1.2E-1	12
Formaldehyde	Annual	1.23E-1	7.7E-2	160
Arsenic	Annual	1.47E-4	2.3E-4	64
Beryllium	Annual	1.47E-5	4.2E-3	0.3
Cadmium	Annual	3.81E-5	5.6E-4	7
Chromium 6+	Annual	1.08E-4 (8.52E-5[c])	8.3E-5	130
Nickel	Annual	1.19E-2 (1.22E-2[c])	4.2E-3	283

[a]Micrograms per cubic meter
[b]Acceptable Ambient Concentration or Acceptable Ambient Concentration for a Carcinogen
[c]Modeled concentration using Spokane, Washington, meteorological data

Figure 2 shows concentration contours for Chromium 6+ and Figure 3 shows concentration contours for Nickel, both carcinogenic compounds that present a health concern from a chronic exposure standpoint. The concentration contours for chromium 6+ and nickel appear substantially different in shape from each other. This is primarily a result from the emissions release parameters. Chromium 6+ emissions occur predominantly from fugitive emissions associated with the ready mix concrete batch plant, while nickel emissions occur mainly from the HMA dryer stack. Maximum modeled chromium 6+ impacts occur in the industrial area along the northern boundary of the facility. Maximum nickel concentrations occur immediately north of the HMA stack, near the road transecting the facility.

AACCs were used to generate factors to convert modeled concentrations at all receptors to cancer risk levels per million people exposed for a 70-year duration. AACCs are based on a 1-in-1,000,000 risk for a 70-year continuous exposure. Total risks for each receptor were determined by summing the risk for all carcinogenic air toxics at that location. The location of maximum risk was then identified, along with the maximum risk at a residential location and at a neighboring business location. Table 14 provides specific air toxics concentrations at the three different locations of maximum risk. Nickel and Chromium 6+ were also modeled using Spokane meteorological data, and results are listed in Table 14. Results for Spokane data are very close to those obtained for Boise data, although somewhat lower.

Table 14. CONCENTRATIONS OF TOXIC SUBSTANCES AT LOCATIONS OF MAXIMUM RISK			
Parameter	Maximum Offsite Risk	Maximum Residential Risk	Maximum Neighboring Business Risk
Location (UTM)			
Easting (meters)	569251	569189	569189
Northing (meters)	4971977	4971653	4972223
Concentrations ($\mu g/m^3$)			
Arsenic	7.27E-5	2.88E-5	8.79E-5
Beryllium	5.53E-6	2.02E-6	7.45E-6
Cadmium	3.62E-5	2.06E-5	1.66E-5
Chromium 6+	6.04E-5 (4.51E-5)[a]	2.55E-5 (2.08E-5)[a]	6.63E-5 (2.67E-5)[a]
Nickel	1.13E-2 (1.17E-2)[a]	6.42E-3 (5.14E-3)[a]	5.26E-3 (4.28E-3)[a]
Acetaldehyde	3.68E-2	2.11E-2	1.64E-2
Benzene	1.37E-2	6.53E-3	5.24E-3
Formaldehyde	1.22E-1	5.32E-2	4.36E-2
POM	5.18E-4	4.67E-5	6.78E-5
Dioxins / Furans	1.1E-10	6E-11	5E-11
[a] Modeled concentration using Spokane, Washington, meteorological data			

Data from Table 14 were used by DEQ air toxics staff to conduct a refined risk assessment. Results of the refined risk assessment are given in Appendix E of the DEQ Statement of Basis.

4.0 Conclusions

The ambient air impact analyses demonstrated to DEQ's satisfaction that emissions from the facility will not cause or significantly contribute to a violation of any air quality standard.

Figure 1 - Facility-Wide Maximum 24-Hour Impacts of PM10 - Wet Season, Excluding Roadway

Concentrations in Micrograms per Cublic Meter

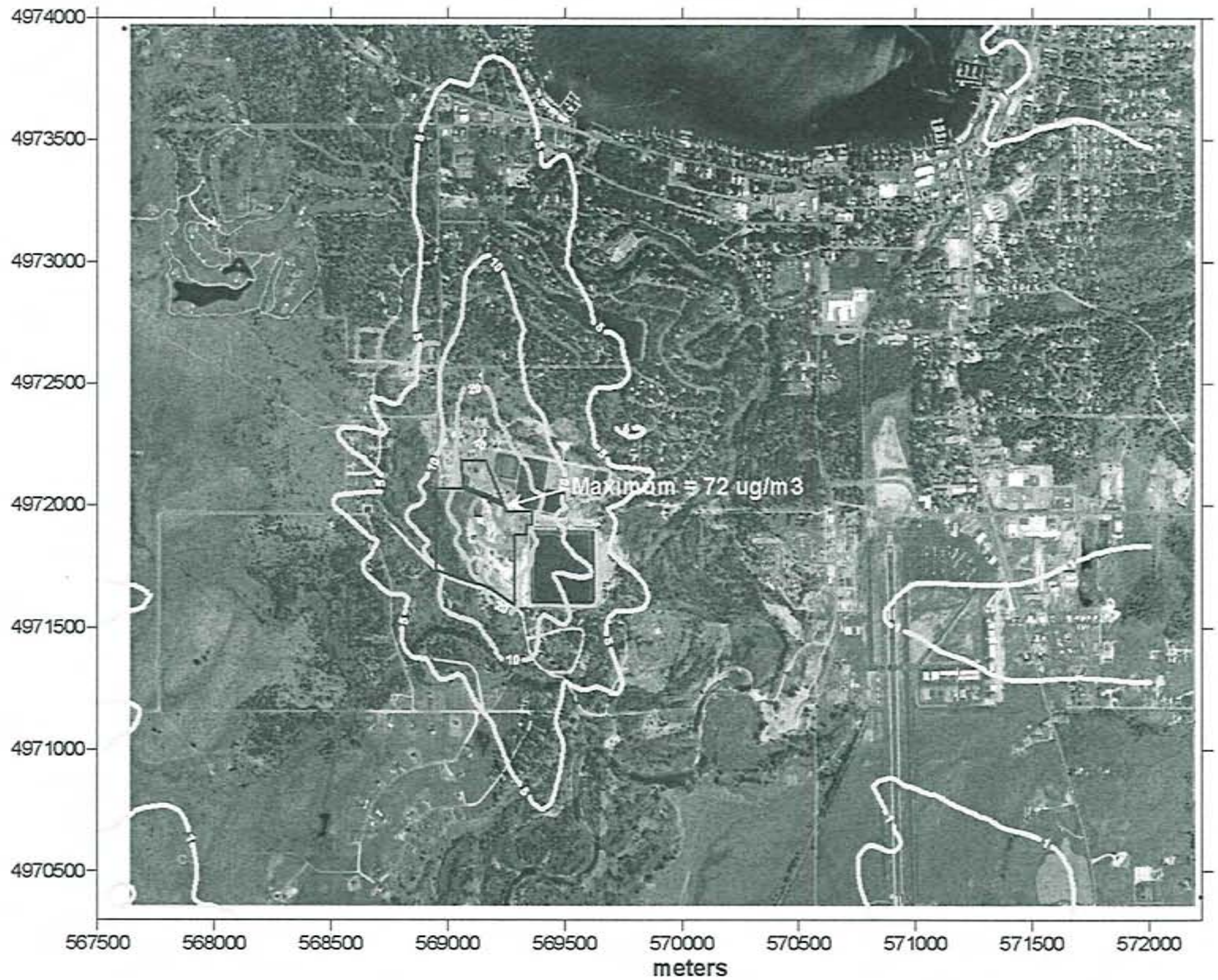


Figure 2 - Facility-Wide Maximum Annual Impacts of Chromium 6+

Concentrations in Micrograms per Cublic Meter

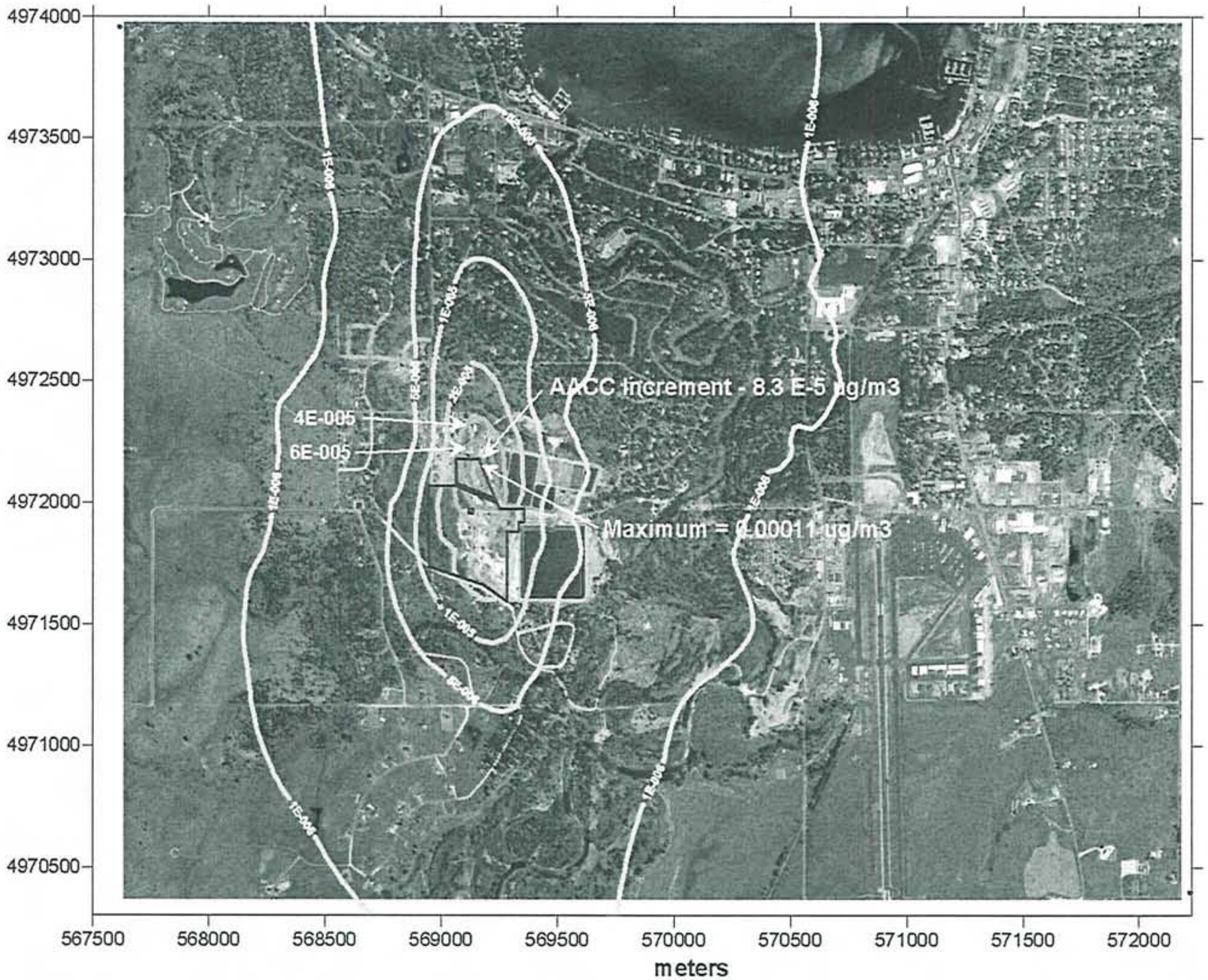
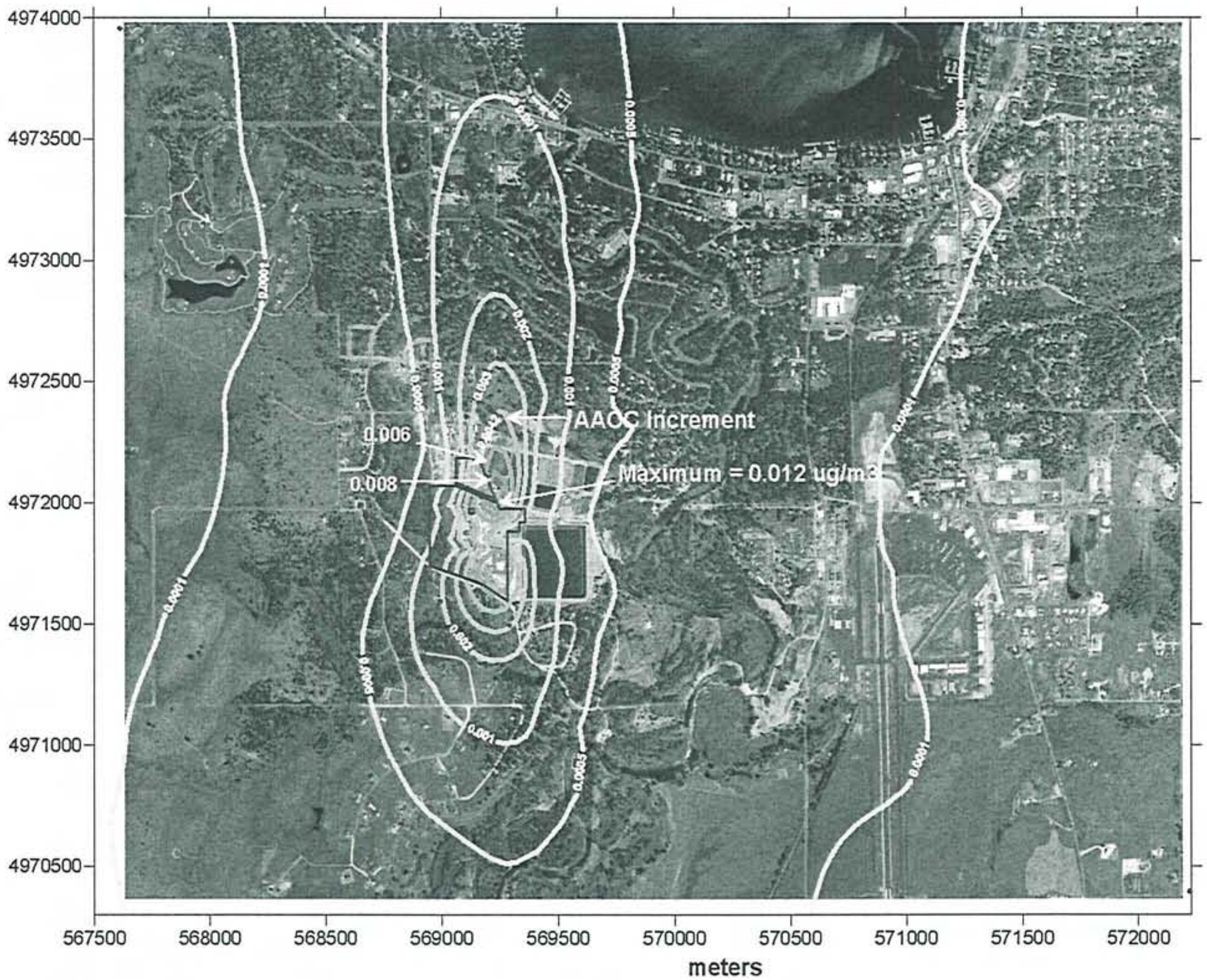


Figure 3 - Facility-Wide Maximum Annual Impacts of Nickel

Concentrations in Micrograms per Cublic Meter



ATTACHMENT A

Modeling Analysis Calculation Sheets:

Establishment of Facility Layout in Model

From Google Earth, coordinates of the northwest and southwest fence corner of the large water treatment pond are E569343, N4971916 and E 569342, N4971594.

Length of segment = 916 meters – 594 meters = 322 meters
Distance on provided map = 14.5 cm

Scale of map = 322 meters / 14.5 cm = 22.2 m/cm
Origin of map: x = +0.8 cm (distance from south-most fence corner) ➢ +17.76 m ➢ 569360 m
y = -0.35 cm (distance from south-most fence corner) ➢ -7.77 m ➢ 4971586 m

Map distances listed below are the distances from the map origin at the lower right corner of the map.

Map Point	Distance from Origin to Point (cm)	Site Distance from Origin to Point (m)	UTM Coordinates of Point (m)
1E	-3.45	-76.59	569283
1N	0.3	6.66	4971593
2E	-8.2	-182.0	569178
2N	3.55	78.8	4971665
3E	-18.5	-410.7	568949
3N	6.8	151.0	4971737
4E	-18.45	-409.6	568950
4N	21.85	485.1	4972071
5E	-13.4	-297.5	569063
5N	21.85	485.1	4972071
6E	-13.4	-297.5	569063
6N	22.35	496.2	4972082
7E	-13.45	-289.6	569061
7N	26.9	597.2	4972183
8E	-8.85	-196.5	569164
8N	26.9	597.2	4972183
9E	-8.85	-196.5	569164
9N	26.35	585.0	4972171
10E	-5.75	-127.7	569232
10N	19.3	428.5	4972014
11E	-5.4	-119.9	569240
11N	18.6	412.9	4971999
12E	-4.9	-108.8	569251
12N	17.6	390.7	4971977
13E	-2.6	-57.7	569302
13N	17.6	390.7	4971977
14E	0	0	569360
14N	17.6	390.7	4971977
15E	0	0	569360
15N	15.1	335.2	4971921
16E	-1.15	-25.5	569334
16N	15.1	335.2	4971921
17E	-1.15	-25.5	569334
17N	13.35	296.4	4971882
18E	-3.45	-76.6	569283
18N	13.35	296.4	4971882

The center of the concrete batch plant is at:
E -10.45 cm ➢ -232.0 m ➢ 569128 m
N 17.1 cm ➢ 379.6 m ➢ 4971966 m

The center of the asphalt plant is at:
E -5.0 cm ➢ -111.0 m ➢ 569249 m
N 13.1 cm ➢ 290.8 m ➢ 4971877 m

The center of the crusher plant is at:
E -9.2 cm ➢ -204.2 m ➢ 569156 m
N 13.8 cm ➢ 306.4 m ➢ 4971892 m

Modeled Emissions Rates

PM_{10} Emissions Rates from Drum Dryer:

Previous PM_{10} estimates from 1993 analyses

Emissions calculated on basis of 0.04 gr/dscf NSPS requirement and flow rate from source

$$\frac{15{,}975 \text{ dscf}}{\text{min}} \cdot \frac{0.04 \text{ gr}}{\text{dscf}} \cdot \frac{1.0 \text{ lb}}{7{,}000 \text{ gr}} \cdot \frac{60 \text{ min}}{\text{hr}} = \frac{5.48 \text{ lb PM}}{\text{hr}}$$

The tech memo references AP42 as PM_{10} = 32% of PM

$$PM_{10} = \frac{5.48 \text{ lb PM}}{\text{hr}} \cdot \frac{0.32\ PM_{10}}{\text{PM}} = \frac{1.75 \text{ lb } PM_{10}}{\text{hr}}$$

The old and applicant-proposed new permit allowable rate is 1.8 lb/hr. This rate does not account for condensable particulate. Also, this rate is independent of the processing rate, except as flow increases.

Annual limit in permit is 1.2 ton/yr:

$$\text{Annual } PM_{10} = \frac{1.2 \text{ ton } PM_{10}}{\text{yr}} \cdot \frac{2000 \text{ lb}}{\text{ton}} \cdot \frac{\text{yr}}{8760 \text{ hr}} = \frac{0.274 \text{ lb } PM_{10}}{\text{hr}}$$

Revised emissions estimates based on 2004 AP42 factor for drum dryer with a venturi scrubber.

Total PM = 0.045 lb/ton of HMA
Filterable PM = 0.026 lb/ton of HMA
Condensable PM = 0.0074 lb/ton + 0.012 lb/ton = 0.194 lb/ton of HMA

All of condensable PM is PM_{10}.
The PM_{10} fraction of filterable PM was not determined in AP42. To estimate the PM_{10} fraction, the PM_{10}/PM ratio for filterable particulate when using a fabric filter was used:

$$\frac{0.0039 \text{ lb/ton}}{0.014 \text{ lb/ton}} = 0.279\ PM_{10} \text{ fraction}$$

<u>Total 24-hour PM_{10} Emissions After Modification</u> – modification increases throughput by 100 ton/hr

but does not increase annual throughput

Filterable PM_{10}: $\frac{0.026 \text{ lb PM}}{\text{ton}} \left| \frac{300 \text{ ton}}{\text{hr}} \right| \frac{0.279 \; PM_{10}}{PM} = \frac{2.176 \text{ lb } PM_{10}}{\text{hr}}$

Condensable PM_{10}: $\frac{(0.0074 \text{ lb} + 0.012 \text{ lb}) \text{ PM}}{\text{ton}} \left| \frac{300 \text{ ton}}{\text{hr}} \right| \frac{1.00 \; PM_{10}}{PM} = \frac{5.820 \text{ lb } PM_{10}}{\text{hr}}$

Total PM_{10} = 2.176 lb/hr + 5.820 lb/hr = 7.996 lb/hr ≈ 8.0 lb/hr PM_{10}
Total annual Average PM_{10} Emissions After Modification – allowable annual throughput of 280,000 ton HMA/yr

Filterable PM_{10}: $\frac{0.026 \text{ lb PM}}{\text{ton}} \left| \frac{280{,}000 \text{ ton}}{\text{yr}} \right| \frac{0.279 \; PM_{10}}{PM} \left| \frac{\text{yr}}{8760 \text{ hr}} \right| = \frac{0.2319 \text{ lb } PM_{10}}{\text{hr}}$

Condensable PM_{10}: $\frac{(0.0074 \text{ lb} + 0.012 \text{ lb}) \text{ PM}}{\text{ton}} \left| \frac{280{,}000 \text{ ton}}{\text{yr}} \right| \frac{\text{yr}}{8760 \text{ hr}} \left| \frac{1.00 \; PM_{10}}{PM} \right. = \frac{0.6201 \text{ lb } PM_{10}}{\text{hr}}$

Total PM_{10} = 0.2319 lb/hr + 0.6201 lb/hr = 0.8520 lb/hr ≈ 0.85 lb/hr PM_{10}

PM_{10} 24-hour Emissions Increase - Although the actual increase is only 100 ton/hr, the change in allowable emissions is greater because the previous limit was only 1.8 lb/hr. Increase emissions are total new emissions minus the existing permit allowable:

Increase PM_{10} = 8.0 lb/hr – 1.8 lb/hr = 6.2 lb/hr

PM_{10} Annual Emissions Increase - Future allowable minus existing allowable

Increase PM_{10} = 0.852 lb/hr – 0.274 lb/hr (1.2 ton/yr) = 0.578 lb/hr ➢ 2.53 ton PM_{10}/yr

CO Emissions Rates from Drum Dryer:

Emissions factor from AP42 Table 11.1-7 = 0.13 lb/ton for all fuels.

Existing permit allowable rate = 7.6 lb/hr

Total Hourly CO Emissions

$$\frac{0.13 \text{ lb CO}}{\text{ton}} \left| \frac{300 \text{ ton}}{\text{hr}} \right. = \frac{39.0 \text{ lb CO}}{\text{hr}}$$

Hourly Increase CO Emissions – total emissions minus existing permit allowable

Increase = 39.0 lb/hr – 7.6 lb/hr = 31.4 lb/hr CO

SO_2 Emissions Rates from Drum Dryer:

Emissions factor from AP42 Table 11.1-7 = 0.011 lb/ton for No. 2 oil
0.058 lb/ton for waste oil

Existing permit allowable rate = 29.2 lb/hr, 20.4 ton/yr (4.658 lb/hr)

Total Hourly SO_2 Emissions

$$\frac{0.058 \text{ lb } SO_2}{\text{ton}} \left| \frac{300 \text{ ton}}{\text{hr}} \right. = \frac{17.4 \text{ lb } SO_2}{\text{hr}}$$

Total Annual SO_2 Emissions

$$\frac{0.058 \text{ lb } SO_2}{\text{ton}} \left| \frac{280{,}000 \text{ ton}}{\text{yr}} \right| \frac{\text{yr}}{8760 \text{ hr}} = \frac{1.854 \text{ lb } SO_2}{\text{hr}}$$

Hourly Increase SO_2 Emissions - total hourly emissions minus existing allowable

Increase = 17.4 lb/hr – 29.2 lb/hr = < 0.0 lb/hr SO_2 increase

Existing allowable emissions substantially over represent actual emissions.

Annual Increase SO_2 Emissions – annual average emissions minus existing allowable

Increase = 1.854 lb/hr – 4.658 lb/hr = < 0.0 lb/hr SO_2 increase

Existing allowable emissions substantially over represent actual emissions.

NOx Emissions Rates from Drum Dryer:

Emissions factor from AP42 Table 11.1-7 = 0.055 lb/ton for all fuels.

Existing permit allowable rate = 5 ton/yr ➢ 1.142 lb/hr average

Total Annual NOx Emissions

$$\frac{0.055 \text{ lb NOx}}{\text{ton}} \left| \frac{280{,}000 \text{ ton}}{\text{yr}} \right| \frac{\text{yr}}{8760 \text{ hr}} = \frac{1.758 \text{ lb NOx}}{\text{hr}}$$

Annual Increase NOx Emissions – annual average emissions minus existing allowable

Increase = 1.758 lb/hr – 1.142 lb/hr = 0.6160 lb/hr NOx increase

PM_{10} Emissions from Asphalt Loadout and Silo Filling

Emissions rates from AP42 11.1 Hot Mix Asphalt Plants

Loadout emissions factor: PM lb/ton = $0.000181 + 0.00141(-V)e^{c}$

Where:

V = asphalt volatility (default = -0.5)
c = ((0.0251)(T+460) – 20.43) T= Temp °F of asphalt (default = 325° F)
= -0.7265

EF = $0.000181 + 0.00141(-(-0.5))e^{-0.7265}$ = 5.219 E-4 lb/ton HMA
Assume 100% of PM is PM_{10}

Silo filling emissions factor: PM lb/ton = $0.000332 + 0.00105(-V)e^{c}$

EF = $0.000332 + 0.00105(-(-0.5))e^{-0.7265}$ = 5.859 E-4 lb/ton HMA
Assume 100% of PM is PM_{10}

Total Hourly PM_{10} Emissions

Loadout: $\frac{5.219\text{ E-4 lb } PM_{10}}{\text{ton}} \left| \frac{300\text{ ton}}{\text{hr}} \right. = \frac{0.1566\text{ lb } PM_{10}}{\text{hr}}$

Silo filling: $\frac{5.859\text{ E-4 lb } PM_{10}}{\text{ton}} \left| \frac{300\text{ ton}}{\text{hr}} \right. = \frac{0.1758\text{ lb } PM_{10}}{\text{hr}}$

Total Annual PM_{10} Emissions

Loadout: $\frac{5.219\text{ E-4 lb } PM_{10}}{\text{ton}} \left| \frac{280{,}000\text{ ton}}{\text{yr}} \right| \frac{\text{yr}}{8760\text{ hr}} = \frac{0.01668\text{ lb } PM_{10}}{\text{hr}}$

Silo filling: $\frac{5.859\text{ E-4 lb } PM_{10}}{\text{ton}} \left| \frac{280{,}000\text{ ton}}{\text{yr}} \right| \frac{\text{yr}}{8760\text{ hr}} = \frac{0.01873\text{ lb } PM_{10}}{\text{hr}}$

Hourly Increase PM_{10} Emissions - The emissions increase is that associated with increased production of 100 ton/hr of HMA

Loadout: $\frac{5.219\text{ E-4 lb } PM_{10}}{\text{ton}} \left| \frac{100\text{ ton}}{\text{hr}} \right. = \frac{0.05219\text{ lb } PM_{10}}{\text{hr}}$

Silo filling: $\frac{5.859\text{ E-4 lb } PM_{10}}{\text{ton}} \left| \frac{100\text{ ton}}{\text{hr}} \right. = \frac{0.05859\text{ lb } PM_{10}}{\text{hr}}$

Annual Increase PM_{10} Emissions - there is no increase in annual allowable production; therefore, there is no increase in annual emissions from these sources.

CO Emissions from Asphalt Loadout and Silo Filling

Emissions rates from AP42 11.1 Hot Mix Asphalt Plants

Loadout emissions factor: CO lb/ton = $0.00558(-V)e^{c}$

Where:

V = asphalt volatility (default = -0.5)
c = ((0.0251)(T+460) – 20.43) T= Temp °F of asphalt (default = 325° F)
= -0.7265

EF = $0.00558(-(-0.5))e^{-0.7265}$ = 1.349 E-3 lb/ton HMA

Silo filling emissions factor: CO lb/ton = $0.00488(-V)e^{c}$

EF = $0.00488(-(-0.5))e^{-0.7265}$ = 1.180 E-3 lb/ton HMA

Total Hourly CO Emissions

Loadout: $\frac{1.349\text{ E-3 lb CO}}{\text{ton}} \Big| \frac{300\text{ ton}}{\text{hr}} = \frac{0.4047\text{ lb CO}}{\text{hr}}$

Silo filling: $\frac{1.180\text{ E-3 lb CO}}{\text{ton}} \Big| \frac{300\text{ ton}}{\text{hr}} = \frac{0.3540\text{ lb CO}}{\text{hr}}$

Hourly Increase CO Emissions - The emissions increase is that associated with increased production of 100 ton/hr of HMA

Loadout: $\frac{1.349\text{ E-3 lb CO}}{\text{ton}} \Big| \frac{100\text{ ton}}{\text{hr}} = \frac{0.1349\text{ lb CO}}{\text{hr}}$

Silo filling: $\frac{1.180\text{ E-3 lb CO}}{\text{ton}} \Big| \frac{100\text{ ton}}{\text{hr}} = \frac{0.1180\text{ lb CO}}{\text{hr}}$

PM_{10} from Conveyor Transfer Points

Emissions factors from AP42 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing. Assume 6 transfer points.

PM_{10} uncontrolled = 0.00110 lb/ton
PM_{10} controlled by wet suppression = 4.6 E-5 lb/ton

Assume aggressive controls will be implemented to control emissions

Total hourly emissions:

$$\frac{4.6\text{ E-5 lb }PM_{10}}{\text{ton}} \Big| \frac{300\text{ ton}}{\text{hr}\cdot\text{point}} \Big| \frac{6\text{ points}}{} = \frac{0.08280\text{ lb }PM_{10}}{\text{hr}}$$

Total annual emissions:

$$\frac{4.6\text{ E-5 lb }PM_{10}}{\text{ton}} \Big| \frac{280{,}000\text{ ton}}{\text{yr}\cdot\text{point}} \Big| \frac{6\text{ points}}{} \Big| \frac{\text{yr}}{8760\text{ hr}} = \frac{8.822\text{ E-3 lb }PM_{10}}{\text{hr}}$$

PM_{10} 24-hour emissions increase:

$$\frac{4.6\text{ E-5 lb }PM_{10}}{\text{ton}} \Big| \frac{100\text{ ton}}{\text{hr}\cdot\text{point}} \Big| \frac{6\text{ points}}{} = \frac{2.760\text{ E-2 lb }PM_{10}}{\text{hr}}$$

PM_{10} annual emissions increase: No increase since no increase in throughput

TAP Emissions Rates increase from Drum Dryer and other sources

HCl Emissions

Emissions factor of 0.00021 lb/ton of HMA from AP42 Table 11.1-8 for burning waste oil in the drum dryer. There are no available rates for other fuels, so it was assumed existing emissions are 0.0 lb/ton.

Increase and total emissions:

$$\frac{0.00021\ \text{lb HCl}}{\text{ton}} \;\Big|\; \frac{300\ \text{ton}}{\text{hr}} = \frac{0.0630\ \text{lb HCl}}{\text{hr}}$$

Propionaldehyde Emissions

Emissions factor of 0.00013 lb/ton of HMA from AP42 Table 11.1-10 for burning waste oil in the drum dryer. There are no available rates for other fuels, so it was assumed existing emissions are 0.0 lb/ton.

Increase and total emissions:

$$\frac{0.00013\ \text{lb Prop.}}{\text{ton}} \;\Big|\; \frac{300\ \text{ton}}{\text{hr}} = \frac{0.0390\ \text{lb Prop.}}{\text{hr}}$$

Quinone Emissions

Emissions factor of 0.00016 lb/ton of HMA from AP42 Table 11.1-10 for burning waste oil in the drum dryer. There are no available rates for other fuels, so it was assumed existing emissions are 0.0 lb/ton.

Increase and total emissions:

$$\frac{0.00016\ \text{lb Quinone}}{\text{ton}} \;\Big|\; \frac{300\ \text{ton}}{\text{hr}} = \frac{0.0480\ \text{lb Quinone}}{\text{hr}}$$

Acetaldehyde Emissions

Emissions factor of 0.0013 lb/ton of HMA from AP42 Table 11.1-10 for burning waste oil in the drum dryer. There are no available rates for other fuels, so it was assumed existing emissions are 0.0 lb/ton.

Increase and total emissions:

$$\frac{0.0013\ \text{lb Acetald.}}{\text{ton}} \;\Big|\; \frac{280{,}000\ \text{ton}}{\text{yr}} \;\Big|\; \frac{\text{yr}}{8760\ \text{hr}} = \frac{0.04155\ \text{lb Acetald.}}{\text{hr}}$$

Total TAP Emissions from HMA Plant

TAP emissions rates were based on emissions factors from AP42 11.1 *Hot Mix Asphalt Plants*.

An Excel calculation spreadsheet was used to calculate TAP emissions. A copy of this spreadsheet is provided below. In model, emissions are lb/hr X 1,000.

Emissions from Drum Dryer

A 70% control of particulate TAPs by the scrubber system was assumed. Particulate TAPs include arsenic, beryllium, cadmium, chromium 6+, and nickel.

Emissions of hexavalent chromium are not given for emissions from a drum dryer stack controlled by a scrubber. Total chromium emissions for an uncontrolled fuel oil fired dryer are given at 2.4 E-5 lb/ton. The hexavalent chromium fraction of total chromium emissions was estimated by calculating a hexavalent chromium to total chromium fraction for the following drum dryer scenarios: 1) Natural gas fired with a fabric filter 4.5 E-7 Cr 6+ / 5.5 E-6 total Cr = 8.2% Cr 6+; 2) No. 2 oil fired or waste oil/No. 6 oil with fabric filter 4.5 E-7 Cr6+ / 5.5 E-6 total Cr = 8.2% Cr 6+. Therefore, the Cr6+ factor is 2.4 E-5 lb/ton X 0.082 = 1.968 E-6 lb/ton.

Particulate TAPs (controlled by 70% by the venturi scrubber) are as follows for a production rate of 280,000 ton/yr of HMA:

Emissions of polycyclic organic matter (POM) are regulated as the sum of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene with a toxicity equal to benzo(a)pyrene. Emissions of dioxins and furans are regulated as a total of all isomers with each adjusted for a toxicity equivalent to 2,3,7,8 tetrachlorodibenzo-p-dioxin. Emissions factors for POM and dioxins/furans were not available for HMA drum dryers using a scrubber as emissions control; therefore, emissions factors for uncontrolled operations were used, selecting the highest factor associated with potential fuel type.

Emissions of formaldehyede, acetaldehyde, and benzene were base on emissions factors for a drum dryer fired by waste oil. It was assumed the scrubber would have no effect on these emissions.

<u>Emissions from Asphalt Loadout and Silo Filling</u>

Emissions of toxics are based on organic PM emissions and total organic carbon (TOC) emissions from HMA loadout and silo filling.

Drum mix plant loadout

Organic PM lb/ton = $0.00141(-V)e^{c}$

Where:

V = asphalt volatility (default = -0.5)
c = ((0.0251)(T+460) – 20.43) T= Temp °F of asphalt (default = 325° F)
= -0.7265

EF = $0.00141(-(-0.5))e^{-0.7265}$ = 3.409 E-4 lb/ton HMA

TOC lb/ton = $0.0172(-V)e^{c}$

EF = $0.0172(-(-0.5))e^{-0.7265}$ = 4.159 E-3 lb/ton HMA

Drum mix silo filling

Organic PM lb/ton = $0.00105(-V)e^{c}$

EF = $0.00105(-(-0.5))e^{-0.7265}$ = 2.539 E-4 lb/ton HMA

TOC lb/ton = $0.0504(-V)e^{c}$

EF = $0.0504(-(-0.5))e^{-0.7265}$ = 1.219 E-2 lb/ton HMA

Facility wide TAPs	Throughput	280000	ton/yr		
		drum dryer			
Dioxins/furand	**factor (lb/ton)**	**emissions (T/yr)**	**emissions (lb/hr)**	**equiv. fact.**	**TCDD eq. emissions (lb/hr)**
2,3,7,8 TCDD	2.10E-13	2.94E-11	6.71233E-12	1	6.71233E-12
1,2,3,7,8 PeCDD	3.10E-13	4.34E-11	9.90868E-12	1	9.90868E-12
1,2,3,4,7,8 HxCDD	4.20E-13	5.88E-11	1.34247E-11	0.1	1.34247E-12
1,2,3,6,7,8 HxCDD	1.30E-12	1.82E-10	4.15525E-11	0.1	4.15525E-12
1,2,3,7,8,9 HxCDD	9.80E-13	1.37E-10	3.13242E-11	0.1	3.13242E-12
1,2,3,4,6,7,8 HpCDD	3.40E-11	4.76E-09	1.08676E-09	0.01	1.08676E-11
Octa CDD	2.70E-09	3.78E-07	8.63014E-08	0.0001	8.63014E-12
2,3,7,8 TCDF	9.70E-13	1.36E-10	3.10046E-11	0.1	3.10046E-12
1,2,3,7,8 PeCDF	4.30E-12	6.02E-10	1.37443E-10	0.05	6.87215E-12
2,3,4,7,8 PeCDF	8.40E-13	1.18E-10	2.68493E-11	0.5	1.34247E-11
1,2,3,4,7,8 HxCDF	4.00E-12	5.60E-10	1.27854E-10	0.1	1.27854E-11
1,2,3,6,7,8 HxCDF	1.20E-12	1.68E-10	3.83562E-11	0.1	3.83562E-12
2,3,4,6,7,8 HxCDF	1.90E-12	2.66E-10	6.07306E-11	0.1	6.07306E-12
1,2,3,7,8,9 HxCDF	8.40E-12	1.18E-09	2.68493E-10	0.1	2.68493E-11
1,2,3,4,6,7,8 HpCDF	1.10E-11	1.54E-09	3.51598E-10	0.01	3.51598E-12
1,2,3,4,7,8,9 HpCDF	2.70E-12	3.78E-10	8.63014E-11	0.01	8.63014E-13
Octa CDF	4.80E-12		1.53425E-10	0.0001	1.53425E-14
Total TCDD eq.					1.22084E-10
	Modeled rate = actual rate X 1,000,000				1.221E-04

Loadout	Emit factor lb/ton	emissions lb/hr	Silo Fill	Emit factor lb/ton	emissions lb/hr
Organic PM	3.41E-04	0.010896347	Organic PM	2.54E-04	0.008115525
TOC	4.16E-03	0.132936073	TOC	1.22E-02	0.389634703

	drum dryer factor (lb/ton)	drum dryer emissions (ton/yr)	drum dryer emissions (lb/hr)	loadout factor (% of Oranic PM)	loadout emissions (ton/yr)	loadout emissions (lb/hr)	silo fill factor (% of Oranic PM)	silo fill emissions (ton/yr)	silo fill emissions (lb/hr)
benzo(a)anthracene	2.10E-07	2.940E-05	6.71233E-06	0.019	9.07E-06	2.07E-06	5.60E-02	1.99E-05	4.54E-06
benzo(a)pyrene	9.80E-09	1.372E-06	3.13242E-07	0.0023	1.10E-06	2.51E-07	0.00E+00	0.00E+00	0.00E+00
benzo(b)fluoranthene	1.00E-07	1.400E-05	3.19635E-06	0.0076	3.63E-06	8.28E-07	0.00E+00	0.00E+00	0.00E+00
benzo(k)fluoranthene	4.10E-08	5.740E-06	1.3105E-06	0.0022	1.05E-06	2.40E-07	0.00E+00	0.00E+00	0.00E+00
chrysene	1.80E-07	2.520E-05	5.75342E-06	0.103	4.92E-05	1.12E-05	2.10E-01	7.46E-05	1.70E-05
dibenzo(a,h)anthracene	0.00E+00	0.000E+00	0	0.00037	1.77E-07	4.03E-08	0.00E+00	0.00E+00	0.00E+00
indeno(1,2,3-cd)pyrene	7.00E-09	9.800E-07	2.23744E-07	0.00047	2.24E-07	5.12E-08	0.00E+00	0.00E+00	0.00E+00
TOTAL POM			1.75096E-05			1.47E-05			2.16E-05
Modeled rate = rate x 1000			1.751E-02			1.470E-02			2.159E-02

Annual throughput	280000	ton/yr HMA		
	Loadout		**Silo Fill**	
Organic PM	1.09E-02	lb/hr	0.0081155	lb/hr
TOC	1.33E-01	lb/hr	0.3896347	lb/hr

Revised TAP emissions estimates for drum dryer

particulate control Efficiency 70 percent

Total Chromium rate	2.40E-05	lb/ton total chromium
Cr6+ fraction	0.082	based on ratio of emissions factors of Cr6:Crtotal
Chroumium 6+ rate	1.968E-06	lb/ton

Particulate 586 TAPs	**emissions factor**	**Emissions**		model rate = actual x 1000
	(lb/ton)	**(ton/yr)**	**(lb/hr)**	**(lb/hr)**
arsenic	1.30E-06	5.460E-05	1.247E-05	0.0124658
beryllium	0	0.000E+00	0.000E+00	0
cadmium	4.20E-06	1.764E-04	4.027E-05	0.040274
chromium 6+	1.968E-06	8.266E-05	1.887E-05	0.0188712
nickel	0.0013	5.460E-02	1.247E-02	12.465753

	Drum Dryer	**Emissions**		**loadout**	**loadout**	**loadout**	**silo fill**	**silo fill**	**silo fill**
	(lb/ton)	**(ton/yr)**	**(lb/hr)**	**factor (% of TOC)**	**emissions (ton/yr)**	**emissions (lb/hr)**	**factor (% of TOC)**	**emissions (ton/yr)**	**emissions (lb/hr)**
Gaseous 586 TAPs									
formaldehyde	0.0031	4.340E-01	9.909E-02	0.088	5.12E-04	1.17E-04	0.69	1.178E-02	2.688E-03
acetaldehyde	0.0013	1.820E-01	4.155E-02	0	0.00E+00	0.00E+00	0	0.000E+00	0.000E+00
benzene	0.00039	5.460E-02	1.247E-02	0.052	3.03E-04	6.91E-05	0.032	5.461E-04	1.247E-04

Asphalt Plant Modeling Parameters

Asphalt Plant Stack

Stack height = 24 ft = 7.3 m; stack diameter = 1.1 m
Stack gas temperature = 140° F = 333K
Stack gas flow rate = 47.9 ft/sec = 14.6 m/sec

Asphalt Loadout

Assume loadout silo is 10 m high, 3 m wide, and emits at the midpoint

Initial dispersion coefficients:

σ_{y0} = 3 m / 4.3 = 0.7 m

σ_{z0} = 10 m / 2.15 = 4.65 m

Silo Filling

Assume silo is 10 m high, 3 m wide, and emits at 7.5 m

Initial dispersion coefficients:

σ_{y0} = 3 m / 4.3 = 0.7 m

σ_{z0} = 10 m / 2.15 = 4.65 m

Conveyors

Model as volume source 30 m X 30m, 5 m high and emits at 2.5 m

Initial dispersion coefficients:

σ_{y0} = 30 m / 4.3 = 7.0 m

σ_{z0} = 5 m / 4.3 = 1.2 m

Concrete Batch Plant Modeled Emissions Rates

Emissions were based on a production rate of 80 yd^3/hr, 1920 yd^3/day and 700,800 yd^3/yr

1.0 yd^3 of concrete is equal to about 4,024 lbs

Aggregate Handling Emissions

PM_{10} emissions associated with the handling of aggregate materials were calculated using emissions factors from AP42 Section 13.2.4.

Emissions are calculated using the following emissions equation:

$$E = k(0.0032)\left[\frac{(U/5)^{1.3}}{(M/2)^{1.4}}\right] \quad \text{lb/ton}$$

Where:

k	=	0.35 for PM_{10}
M	=	1.77% for aggregate, 4.17% for sand as per Section 11.12
U	=	wind speed (mph)

In the model, emissions are varied as a function of windspeed.

upper windspeeds for 6 categories: 1.54, 3.09, 5.14, 8.23, 10.8 m/sec

Median windspeed for each category (1 m/sec = 2.237 mph)

Cat 1: (0 + 1.54)/2 = 0.77 m/sec ➢ 1.72 mph
Cat 2: (1.54 + 3.09)/2 = 2.32 m/sec ➢ 5.18 mph
Cat 3: (3.09 + 5.14)/2 = 4.12 m/sec ➢ 9.20 mph
Cat 4: (5.14 + 8.23)/2 = 6.69 m/sec ➢ 14.95 mph
Cat 5: (8.23 + 10.8)/2 = 9.52 m/sec ➢ 21.28 mph
Cat 6: (10.8 + 14)/2 = 12.4 m/sec ➢ 27.74 mph

<u>Aggregate Handling</u>

Base factor – use 10 mph wind: $0.35(0.0032)\frac{(10/5)^{1.3}}{(1.77/2)^{1.4}} = 3.272\ E-3 \quad \text{lb/ton}$

Adjustment factors to put in the model:

Cat 1: $(1.72/5)^{1.3}$ (1.329 E-3) = 3.319 E-4 lb/ton
Factor = 3.319 E-4/3.272 E-3 = 0.1014

Cat 2: $(5.18/5)^{1.3}$ (1.329 E-3) = 1.391 E-3 lb/ton
Factor = 1.391 E-3/3.272 E-3 = 0.4253

Cat 3: $(9.20/5)^{1.3}$ (1.329 E-3) = 2.936 E-3 lb/ton
Factor = 2.936 E-3/3.272 E-3 = 0.8974

Cat 4: $(14.95/5)^{1.3}$ (1.329 E-3) = 5.519 E-3 lb/ton
Factor = 5.519 E-3/3.272 E-3 = 1.687

Cat 5: $(21.28/5)^{1.3}$ (1.329 E-3) = 8.734 E-3 lb/ton
Factor = 8.734 E-3/3.272 E-3 = 2.669

Cat 6: $(27.74/5)^{1.3}$ (1.329 E-3) = 1.233 E-2 lb/ton
Factor = 1.233 E-2/3.272 E-3 = 3.768

1 yd^3 of concrete ≈ 4024 lbs consisting of:
1865 lbs aggregate
1428 lbs sand
491 lbs cement
73 lbs supplemenet
20 gal water

Fraction of aggregate: 1865/4024 = 0.463

Base PM_{10} factor in terms of lb/yd^3:

$$\frac{3.272\text{ E-3 lb }PM_{10}}{\text{ton}}\left|\frac{0.463\text{ ton agg}}{\text{ton conc.}}\right|\frac{\text{ton}}{2000\text{ lbs}}\left|\frac{4024\text{ lb conc}}{yd^3}\right. = \frac{3.048\text{ E-3 lb}}{yd^3}$$

Daily PM_{10}:

$$\frac{3.048\text{ E-3 lb }PM_{10}}{yd^3}\left|\frac{1920\ yd^3}{\text{Day}}\right|\frac{\text{Day}}{24\text{ hour}} = \frac{0.2438\text{ lb}}{\text{hr}}$$

Annual PM_{10}

$$\frac{3.048\text{ E-3 lb }PM_{10}}{yd^3}\left|\frac{700{,}800\ yd^3}{\text{yr}}\right|\frac{\text{yr}}{8760\text{ hour}} = \frac{0.2438\text{ lb}}{\text{hr}}$$

<u>Sand Handling</u>

Base factor – use 10 mph wind: $0.35\,(0.0032)\dfrac{(10/5)^{1.3}}{(4.17/2)^{1.4}} = 9.858\,\text{E}-4$ lb/ton

Adjustment factors to put in the model: same as for aggregate

1 yd^3 of concrete ≈ 4024 lbs consisting of:
1865 lbs aggregate
1428 lbs sand
491 lbs cement
73 lbs supplemenet
20 gal water

Fraction of sand: 1428/4024 = 0.3549

Base PM_{10} factor in terms of lb/yd^3:

$$\frac{9.858\text{ E-4 lb }PM_{10}}{\text{ton}}\left|\frac{0.3549\text{ ton sand}}{\text{ton conc.}}\right|\frac{\text{ton}}{2000\text{ lbs}}\left|\frac{4024\text{ lb conc}}{yd^3}\right. = \frac{7.039\text{ E-4 lb}}{yd^3}$$

Daily PM_{10}:

$$\frac{7.039\text{ E-4 lb }PM_{10}}{yd^3}\left|\frac{1920\ yd^3}{\text{Day}}\right|\frac{\text{Day}}{24\text{ hour}} = \frac{0.05631\text{ lb}}{\text{hr}}$$

Annual PM_{10}

$$\frac{7.039\text{ E-4 lb }PM_{10}}{yd^3}\left|\frac{700{,}800\ yd^3}{\text{yr}}\right|\frac{\text{yr}}{8760\text{ hour}} = \frac{0.05631\text{ lb}}{\text{hr}}$$

<u>Seasonal Adjustment</u>

Assume moisture content of aggregate is double the normal value during late fall through early spring.

Aggregate Moisture Content = (1.77%)(2) = 3.54%

Base factor – use 10 mph wind: $0.35\,(0.0032)\dfrac{(10/5)^{1.3}}{(3.54/2)^{1.4}} = 1.240\,\mathrm{E}{-3}$ lb/ton

Base PM_{10} factor in terms of lb/yd^3:

1.240 E-3 lb PM_{10}	0.463 ton agg	ton	4024 lb conc	=	1.155 E-3 lb
ton	ton conc.	2000 lbs	yd^3		yd^3

Daily PM_{10}:

1.155 E-3 lb PM_{10}	1920 yd^3	Day	=	0.09241 lb
yd^3	Day	24 hour		hr

Annual PM_{10}: same as daily

<u>Cement Unloading to Silo</u>

<u>PM_{10} Emissions</u>

Emissions factor: 0.00034 lb/ton

1 yd^3 of concrete ≈ 4024 lbs consisting of:
1865 lbs aggregate
1428 lbs sand
491 lbs cement
73 lbs supplemenet
20 gal water

Fraction of cement: 564/4024 = 0.140 (because supplement is not used, the equivalent weight of additional cement will be used)

Base PM_{10} factor in terms of lb/yd^3:

0.00034 lb PM_{10}	0.140 ton cement	ton	4024 lb conc	=	9.577 E-5 lb
ton	ton conc.	2000 lbs	yd^3		yd^3

Daily PM_{10}:

9.577 E-5 lb PM_{10}	1920 yd^3	Day	=	7.662 E-3 lb
yd^3	Day	24 hour		hr

Annual PM_{10}

9.577 E-5 lb PM_{10}	700,800 yd^3	yr	=	7.662 E-3 lb
yd^3	yr	8760 hr		hr

Air Toxics – In model emissions are lb/hr X 1,000

The Cr emissions factor is for total Cr, not just Cr^{6+}. A LEHIGH MSDS stated that up to 0.003% of cement dust may be Cr^{6+}. A PCA survey in the EPA document on cement kiln dust at http://www.epa.gov/epaoswer/other/ckd/rtc/chapt3.pdf states the following characteristics of cement dust:

- Cr content: mean = 39 ppm; min 32.7 ppm, max = 49.0 ppm; median = 35.2 ppm, 3 samples
- Cr^{6+} contenet: mean = 7.8 ppm; min = 7.05 ppm; max = 8.59 ppm; median = 7.82 ppm; 2 samples

Using the mean values the percent of Cr that is Cr6+ in cement dust is given by:

7.82 ppm / 39 ppm = 20%

Annual Average Emissions

As: $$\frac{4.24\text{E-9 lb}}{\text{ton}} \,\Big|\, \frac{0.140 \text{ ton cement}}{\text{ton conc.}} \,\Big|\, \frac{\text{ton}}{2000 \text{ lbs}} \,\Big|\, \frac{4024 \text{ lb conc}}{yd^3} = \frac{1.194\text{E-9 lb}}{yd^3}$$

$$\frac{1.194\text{E-9 lb}}{yd^3} \,\Big|\, \frac{700{,}800\ yd^3}{\text{yr}} \,\Big|\, \frac{\text{yr}}{8760 \text{ hr}} = \frac{9.555\text{E-8 lb}}{\text{hr}}$$

Be: 4.86 E-10 lb/ton ➢ 1.369 E-10 lb/yd^3 ➢ 1.095 E-8 lb/hr

Cd: 4.86 E-10 lb/ton ➢ 1.369 E-10 lb/yd^3 ➢ 1.095 E-8 lb/hr

Cr: 2.90 E-8 lb/ton ➢ 8.169 E-9 lb/yd^3 ➢ 6.535 E-7 lb/hr.
Cr^{6+} = 6.535 E-7 lb/hr (0.20) = 1.307 E-7 lb/hr

Ni: 4.18 E-8 lb/ton ➢ 1.177 E-8 lb/yd^3 ➢ 9.419 E-7 lb/hr

Cement Supplement – not used

Weigh Hopper Loading

PM_{10} Emissions

Emissions factor: 0.0024 lb/ton

1 yd^3 of concrete ≈ 4024 lbs consisting of:
1865 lbs aggregate
1428 lbs sand
491 lbs cement
73 lbs supplemenet
20 gal water

Fraction of cement: (1865 + 1428)/4024 = 0.8183

Base PM_{10} factor in terms of lb/yd^3:

$$\frac{0.0024\ \text{lb}\ PM_{10}}{\text{ton}} \Big| \frac{0.8183\ \text{ton}}{\text{ton conc.}} \Big| \frac{\text{ton}}{2000\ \text{lbs}} \Big| \frac{4024\ \text{lb conc}}{yd^3} = \frac{3.952\ \text{E-3 lb}}{yd^3}$$

Daily PM_{10}:

$$\frac{3.952\ \text{E-3 lb}\ PM_{10}}{yd^3} \Big| \frac{1920\ yd^3}{\text{Day}} \Big| \frac{\text{Day}}{24\ \text{hour}} = \frac{0.3162\ \text{lb}}{\text{hr}}$$

Annual PM_{10}

$$\frac{3.952\ \text{E-3 lb}\ PM_{10}}{yd^3} \Big| \frac{700{,}800\ yd^3}{\text{yr}} \Big| \frac{\text{yr}}{8760\ \text{hour}} = \frac{0.3162\ \text{lb}}{\text{hr}}$$

Was not able to confirm whether emissions from this source were controlled.

Truck Loading

PM_{10} Emissions

No mention in permit that emissions must be controlled. However, photos indicated the presence of a curtain and emissions capture system. Use 95% capture/control for the system.

Emissions factor: 0.278 lb/ton uncontrolled

1 yd^3 of concrete ≈ 4024 lbs consisting of:
1865 lbs aggregate
1428 lbs sand
491 lbs cement
73 lbs supplemenet
20 gal water

Fraction of cement: 564/4024 = 0.140 (because supplement is not used, the equivalent weight of additional cement will be used)

Base PM_{10} factor in terms of lb/yd^3:

$$\frac{0.278\ \text{lb}\ PM_{10}}{\text{ton}} \Big| (1-0.95) \Big| \frac{0.140\ \text{ton}}{\text{ton conc.}} \Big| \frac{\text{ton}}{2000\ \text{lbs}} \Big| \frac{4024\ \text{lb conc}}{yd^3} = \frac{3.915\ \text{E-3 lb}}{yd^3}$$

Daily PM_{10}:

$$\frac{3.915\ \text{E-3 lb}\ PM_{10}}{yd^3} \Big| \frac{1920\ yd^3}{\text{Day}} \Big| \frac{\text{Day}}{24\ \text{hour}} = \frac{0.3132\ \text{lb}}{\text{hr}}$$

Annual PM_{10}

$$\frac{3.915\ \text{E-3 lb}\ PM_{10}}{yd^3} \Big| \frac{700{,}800\ yd^3}{\text{yr}} \Big| \frac{\text{yr}}{8760\ \text{hour}} = \frac{0.3132\ \text{lb}}{\text{hr}}$$

Toxics Emissions

In model emissions are lb/hr X 1,000

Annual Average Emissions

As:

$$\frac{1.16E\text{-}6\ lb}{ton} \left| \frac{0.140\ ton\ cement}{ton\ conc.} \right| \frac{ton}{2000\ lbs} \left| \frac{4024\ lb\ conc}{yd^3} \right. = \frac{3.267E\text{-}7\ lb}{yd^3}$$

$$\frac{3.267E\text{-}7\ lb}{yd^3} \left| \frac{700{,}800\ yd^3}{yr} \right| \frac{yr}{8760\ hr} = \frac{2.614\ E\text{-}5\ lb}{hr}$$

Be: 1.04 E-7 lb/ton ➢ 2.929 E-8 lb/yd^3 ➢ 2.344 E-6 lb/hr

Cd: 9.06 E-9 lb/ton ➢ 2.552 E-9 lb/yd^3 ➢ 2.042 E-7 lb/hr

Cr: 4.10 E-6 lb/ton ➢ 1.155 E-6 lb/yd^3 ➢ 9.239 E-5 lb/hr.
Cr^{6+} = 9.239 E-5 lb/hr (0.20) = 1.848 E-5 lb/hr

Ni: 4.78 E-6 lb/ton ➢ 1.346 E-6 lb/yd^3 ➢ 1.077 E-4 lb/hr

Concrete Batch Plant Modeling Parameters

To account for building downwash, a 10 m X 10 m building 10 meters high was centered on the batch plant.

Aggregate and Sand to Storage

Release emissions in model from a 50 m X 50 m area 3 m high, released at 3 m

Initial dispersion coefficients:

σ_{y0} = 50 m / 4.3 = 11.6 m

σ_{z0} = 3 m / 4.3 = 1.40 m

Sources include: 1) aggregate to storage; 2) sand to storage; 3) aggregate to conveyor; 4) sand to conveyor.

Vary emissions by season.

24-hour and annual PM_{10} emissions (dryer period of May through September):
0.2438 lb/hr + 0.05631 lb/hr + 0.2438 lb/hr + 0.05631 lb/hr = 0.6002 lb/hr

24-hour PM10 emissions (wet period of October through April):
0.09241 lb/hr + 0.05631 lb/hr + 0.09241 lb/hr + 0.05631 lb/hr = 0.2974 lb/hr

Enter dry period emissions into model and use a seasonal adjustment for the period of October through April. The adjustment factor is the ratio of emissions for the wet period to emissions for the dryer period: 0.2974 lb/hr / 0.6002 lb/hr = 0.4955

Aggregate and Sand to Elevated Storage

Assume storage is about 10 m high, 5 m wide, and emits at the midpoint.

Initial dispersion coefficients:

σ_{y0} = 5 m / 4.3 = 1.16 m

σ_{z0} = 10 m / 2.15 = 4.65 m

Sources include: 1) aggregate to elevated storage; 2) sand to elevated storage

Vary emissions by season.

24-hour and annual PM_{10} emissions (dryer period of May through September):
0.2438 lb/hr + 0.05631 lb/hr = 0.3001 lb/hr

24-hour PM10 emissions (wet period of October through April):
0.09241 lb/hr + 0.05631 lb/hr = 0.1487 lb/hr

Enter dry period emissions into model and use a seasonal adjustment for the period of October through April. The adjustment factor is the ratio of emissions for the wet period to emissions for the dryer period: 0.1487 lb/hr / 0.3001 lb/hr = 0.4955

Storage Silo Baghouse

Assume silo 10 m high, 5 m diameter. Model as point source with release at top of silo.

Stack height = 10 m; stack diameter = 1.0 m; stack exit gas velocity = 0.34 msec

Source includes silo loading: PM_{10} 24-hour and annual = 7.662 E-3 lb/hr

Weigh Hopper Loading

Model as volume source centered on building with a release height of 5 m.

Initial dispersion coefficients:

σ_{y0} = 10 m / 4.3 = 2.33 m

σ_{z0} = 10 m / 2.15 = 4.65 m

Source includes truck loading: PM_{10} 24-hour and annual = 0.3162 lb/hr

Truck Loading

Model as volume source centered on building with a release height of 5 m.

Initial dispersion coefficients:

σ_{y0} = 10 m / 4.3 = 2.33 m

σ_{z0} = 10 m / 2.15 = 4.65 m

Source includes truck loading: PM_{10} 24-hour and annual = 0.3132 lb/hr

Crusher Emissions Rates

Emissions were estimated using factors from AP42 11.19.2 Crushed Stone Processing and Pulverized Mineral Processing

Emissions factors are as follows:

Screening:	0.00074 lb PM_{10}/ton
Tertiary crushing:	0.00054 lb PM_{10}/ton
Conveyor transfers	0.000046 lb PM_{10}/ton
Truck unloading	8.0E-6 lb PM_{10}/ton (fragmented stone)

Assumed equipment was the following:

2 screens
1 tertiary crusher
6 conveyor transfers
1 truck unlading

Emissions:

Screening: $\dfrac{0.00074 \text{ lb } PM_{10}}{\text{ton}} \Big| \dfrac{300 \text{ ton}}{\text{hr}} = \dfrac{0.2220 \text{ lb } PM_{10}}{\text{hr}}$

Tert. crushing: $\dfrac{0.00054 \text{ lb } PM_{10}}{\text{ton}} \Big| \dfrac{300 \text{ ton}}{\text{hr}} = \dfrac{0.1620 \text{ lb } PM_{10}}{\text{hr}}$

Conveyor: $\dfrac{0.000046 \text{ lb } PM_{10}}{\text{ton}} \Big| \dfrac{300 \text{ ton}}{\text{hr}} = \dfrac{0.01380 \text{ lb } PM_{10}}{\text{hr}}$

Truck unload: $\dfrac{8.0 \text{ E-6 lb } PM_{10}}{\text{ton}} \Big| \dfrac{300 \text{ ton}}{\text{hr}} = \dfrac{0.002400 \text{ lb } PM_{10}}{\text{hr}}$

Crusher Modeling Parameters

Primary screen: model as volume source in a 5 m X 5 m area 5 meters high, release height 5 m

Initial dispersion coefficients:

σ_{y0} = 5 m / 4.3 = 1.16 m

σ_{z0} = 5 m / 4.3 = 1.16 m

Sources include: 1) screen: 0.220 lb PM_{10}/hr

Tirt. Crusher + screen: model as volume source in a 10 m X 10 m area, 5 m high, release height 5 m.

Initial dispersion coefficients:

σ_{y0} = 10 m / 4.3 = 2.33 m

σ_{z0} = 5 m / 4.3 = 1.16 m

Sources include: 1) tirt. Crusher; 2) screen.
0.1620 lb/hr + 0.2220 lb/hr = 0.384 lb PM_{10}/hr

Conveyors: model as volume source in a 30 m X 30 m area, 5 m high, release height 5 m

Initial dispersion coefficients:

σ_{y0} = 30 m / 4.3 = 6.98 m

σ_{z0} = 5 m / 4.3 = 1.16 m

Sources include: 1) 6 X conveyors
0.01380 lb/hr (6) = 0.0828 lb PM_{10}/hr

Truck unloading: model as volume source in a 5 m X 5 m area, 4 m high, release height 2 m

Initial dispersion coefficients:

σ_{y0} = 5 m / 4.3 = 1.16 m

σ_{z0} = 4 m / 4.3 = 0.93 m

Sources include: 1) truck unloading: 0.002400 lb PM_{10}/hr

Risk Levels Associated with Modeled Concentrations

Modeled concentrations of carcinogenic air toxics were used to calculate cancer risk values for the air inhalation path and a 70-year exposure. Cancer risks per million people exposed were calculated from AACC values by dividing the modeled concentration by the AACC.

Emissions of air toxics used in the modeling analyses were multiplied by 1000 because of the small values and the minimum model concentrations resolved by the model. Dioxins/furans emissions were multiplied by 106 because of the extremely low emissions values and low AACC levels. Therefore, modeled concentrations were in terms of ng/m^3 rather than µg/m^3. The following are factors used to convert concentrations to per million people exposed for 70 years.

Nickel AACC = 4.2 E-3 µg/m^3

Risk Conversion Factor: $\dfrac{\mu g/m^3}{1{,}000\ ng/m^3} \left| \dfrac{\text{Risk/million}}{4.2\text{ E-3 } \mu g/m^3} \right. = \dfrac{0.2381\text{ risk}}{ng/m^3}$

Dioxins and furans AACC = 2.2 E-8 µg/m^3

Risk Conversion Factor: $\dfrac{\mu g/m^3}{10^6\ pg/m^3} \left| \dfrac{\text{Risk/million}}{2.2\text{ E-8 } \mu g/m^3} \right. = \dfrac{45.46\text{ risk}}{pg/m^3}$

POM AACC = 3.0 E-4 µg/m^3

Risk Conversion Factor: $$\frac{\mu g/m^3}{1{,}000\ ng/m^3}\ \bigg|\ \frac{\text{Risk/million}}{3.0\ E\text{-}4\ \ \mu g/m^3} = \frac{3.333\ \text{risk}}{ng/m^3}$$

Acetaldehyde AACC = 4.5 E-1 $\mu g/m^3$

Risk Conversion Factor: $$\frac{\mu g/m^3}{1{,}000\ ng/m^3}\ \bigg|\ \frac{\text{Risk/million}}{4.5\ E\text{-}1\ \ \mu g/m^3} = \frac{0.00222\ \text{risk}}{ng/m^3}$$

Benzene AACC = 1.2 E-1 $\mu g/m^3$

Risk Conversion Factor: $$\frac{\mu g/m^3}{1{,}000\ ng/m^3}\ \bigg|\ \frac{\text{Risk/million}}{1.2\ E\text{-}1\ \ \mu g/m^3} = \frac{0.00833\ \text{risk}}{ng/m^3}$$

formaldehyde AACC = 7.7 E-2 $\mu g/m^3$

Risk Conversion Factor: $$\frac{\mu g/m^3}{1{,}000\ ng/m^3}\ \bigg|\ \frac{\text{Risk/million}}{7.7\ E\text{-}2\ \ \mu g/m^3} = \frac{0.01299\ \text{risk}}{ng/m^3}$$

Arsenic AACC = 2.3 E-4 $\mu g/m^3$

Risk Conversion Factor: $$\frac{\mu g/m^3}{1{,}000\ ng/m^3}\ \bigg|\ \frac{\text{Risk/million}}{2.3\ E\text{-}4\ \ \mu g/m^3} = \frac{4.348\ \text{risk}}{ng/m^3}$$

Beryllium AACC = 4.2 E-3 $\mu g/m^3$

Risk Conversion Factor: $$\frac{\mu g/m^3}{1{,}000\ ng/m^3}\ \bigg|\ \frac{\text{Risk/million}}{4.2\ E\text{-}3\ \ \mu g/m^3} = \frac{0.2381\ \text{risk}}{ng/m^3}$$

Cadmium AACC = 5.6 E-4 $\mu g/m^3$

Risk Conversion Factor: $$\frac{\mu g/m^3}{1{,}000\ ng/m^3}\ \bigg|\ \frac{\text{Risk/million}}{5.6\ E\text{-}4\ \ \mu g/m^3} = \frac{1.786\ \text{risk}}{ng/m^3}$$

Chromium 6+ AACC = 8.3 E-5 $\mu g/m^3$

Risk Conversion Factor: $$\frac{\mu g/m^3}{1{,}000\ ng/m^3}\ \bigg|\ \frac{\text{Risk/million}}{8.3\ E\text{-}5\ \ \mu g/m^3} = \frac{12.05\ \text{risk}}{ng/m^3}$$

Risk Rank	UTM Coordinates		Cancer Risk per Million Exposed at Specific Receptor Locations for Specific Toxic Substances										
	Easting	Northing	Ni	Cr6	Cd	Be	As	CH3O	benzene	acetald	POM	Diox/Fur	Total
1	569251	4971977	2.690294	0.727579	0.064582	0.001317	0.316187	1.581322	0.113979	0.081696	1.726761	0.005001	7.308716
2	569249	4971983	2.81713	0.632987	0.067761	0.001055	0.264967	1.600094	0.116284	0.086012	1.52958	0.005001	7.12087
3	569247.3	4971985	2.825307	0.647929	0.067957	0.00109	0.272402	1.592458	0.115981	0.086216	1.489018	0.005001	7.103358
4	569243.7	4971992	2.820664	0.689019	0.067797	0.001195	0.293577	1.547907	0.113593	0.08592	1.331833	0.005001	6.956506
5	569249	4971993	2.812973	0.656364	0.067636	0.001114	0.277055	1.55317	0.113795	0.085798	1.357531	0.005001	6.930436
6	569240	4971999	2.775587	0.73023	0.066654	0.001307	0.315665	1.486563	0.109848	0.084358	1.179082	0.005001	6.754294
7	569249	4972003	2.783301	0.675403	0.066904	0.001167	0.287446	1.502425	0.110812	0.084798	1.214878	0.005001	6.732133
8	569259	4971983	2.61654	0.562976	0.062974	0.000917	0.233357	1.507727	0.109107	0.079978	1.496884	0.005001	6.675461
9	569239	4972003	2.75241	0.741919	0.066064	0.001341	0.3221	1.46022	0.108201	0.08359	1.118855	0.005001	6.659699
10	569259.5	4971977	2.503536	0.5543	0.060242	0.000917	0.23127	1.491086	0.106906	0.076467	1.62987	0.004546	6.65914
11	569259	4971993	2.626741	0.584787	0.063189	0.000969	0.244271	1.470031	0.107281	0.080219	1.3366	0.005001	6.519087
12	569249	4972013	2.738221	0.677692	0.065796	0.001181	0.289533	1.451055	0.107625	0.083379	1.092857	0.005001	6.51234
13	569236	4972007	2.694892	0.76156	0.064653	0.001402	0.333405	1.412792	0.105033	0.081715	1.03733	0.005001	6.497783
14	569239	4972013	2.711938	0.739991	0.0651	0.001345	0.322013	1.416584	0.105471	0.082329	1.018265	0.005001	6.468036
15	569259	4972003	2.617045	0.604187	0.062939	0.001019	0.254445	1.429601	0.105076	0.079843	1.200113	0.005001	6.359268
16	569249	4972023	2.671558	0.66998	0.064189	0.001176	0.286968	1.396241	0.104011	0.081315	0.993301	0.005001	6.273739
17	569239	4972023	2.650908	0.729025	0.063617	0.001329	0.317621	1.368332	0.102265	0.080455	0.933707	0.005001	6.25226
18	569232	4972014	2.575066	0.79036	0.061706	0.001498	0.350623	1.328457	0.099196	0.077857	0.921475	0.004546	6.210783
19	569259	4972013	2.589173	0.61214	0.062242	0.001045	0.259097	1.386664	0.10253	0.078942	1.082758	0.004546	6.179137
20	569249	4972033	2.598873	0.657328	0.062439	0.001157	0.282011	1.342664	0.100389	0.079083	0.907709	0.004546	6.036198
21	569239	4972033	2.58308	0.715891	0.061992	0.001307	0.312317	1.319895	0.098965	0.078377	0.859381	0.004546	6.03575
22	569259	4972023	2.540556	0.60961	0.061063	0.001048	0.258836	1.34018	0.099563	0.077428	0.985768	0.004546	5.978598
23	569229	4972023	2.471171	0.802892	0.05917	0.00155	0.359232	1.256785	0.094224	0.074555	0.824118	0.004546	5.948242
24	569228.2	4972023	2.453271	0.809519	0.058724	0.001569	0.362971	1.246425	0.09346	0.07397	0.815785	0.004546	5.92024
25	569268	4971977	2.222159	0.486941	0.053473	0.0008	0.20266	1.321342	0.094717	0.067891	1.43119	0.004091	5.885264
26	569239	4972043	2.509955	0.709143	0.060206	0.001305	0.310447	1.271529	0.095592	0.076108	0.79612	0.004546	5.834951
27	569249	4972043	2.520743	0.649375	0.060545	0.001152	0.279576	1.290114	0.096746	0.076663	0.83655	0.004546	5.816011
28	569229	4972033	2.431137	0.790721	0.058206	0.001526	0.353797	1.22556	0.092147	0.073344	0.76909	0.004546	5.800074
29	569269	4971983	2.240802	0.489953	0.053919	0.000805	0.203791	1.301233	0.093905	0.068466	1.319601	0.004091	5.776567
30	569259	4972033	2.483124	0.599849	0.059688	0.001033	0.25501	1.293623	0.096489	0.075663	0.90201	0.004546	5.771035

31	569269	4971993	2.290334	0.510318	0.055098	0.000845	0.213269	1.291502	0.094009	0.069944	1.20108	0.004091	5.730491
32	569229	4972043	2.381721	0.791444	0.057009	0.001538	0.355232	1.191469	0.08979	0.071793	0.721928	0.004546	5.666469
33	569269	4972003	2.312725	0.530803	0.055616	0.000893	0.22327	1.273282	0.093344	0.070571	1.096624	0.004091	5.661219
34	569239	4972053	2.436823	0.708661	0.058438	0.001319	0.311708	1.224871	0.092296	0.073818	0.740459	0.004546	5.652939
35	569224.4	4972032	2.330652	0.83133	0.055723	0.001648	0.376711	1.167103	0.087844	0.070047	0.722294	0.004091	5.647443
36	569249	4972053	2.444849	0.641904	0.058706	0.001148	0.277315	1.240437	0.093271	0.074311	0.772656	0.004546	5.609143
37	569259	4972043	2.418872	0.591294	0.058134	0.001026	0.25201	1.247337	0.093342	0.073679	0.831517	0.004546	5.571757
38	569269	4972013	2.312984	0.544901	0.055616	0.000929	0.230488	1.24881	0.092092	0.070528	1.0046	0.004091	5.565039
39	569229	4972053	2.329268	0.799879	0.055723	0.001569	0.360667	1.1567	0.087344	0.070118	0.678699	0.004091	5.544058
40	569239	4972063	2.365362	0.71577	0.056688	0.00135	0.316882	1.18031	0.089119	0.071552	0.691698	0.004091	5.492822
41	569220.7	4972040	2.216073	0.87471	0.052883	0.001781	0.40132	1.0955	0.082689	0.066301	0.649135	0.004091	5.444483
42	569269	4972023	2.295844	0.548155	0.055187	0.00094	0.232488	1.219972	0.090412	0.069979	0.923474	0.004091	5.440543
43	569229	4972063	2.274869	0.810001	0.054384	0.001605	0.366971	1.121669	0.084862	0.068375	0.63817	0.004091	5.424997
44	569249	4972063	2.369924	0.638771	0.056884	0.001155	0.277315	1.192992	0.089919	0.071974	0.716628	0.004546	5.420109
45	569259	4972053	2.353619	0.582738	0.056563	0.001017	0.248967	1.202622	0.090258	0.071666	0.768457	0.004091	5.379997
46	569239	4972073	2.295501	0.718662	0.054991	0.001371	0.319839	1.1373	0.086042	0.069352	0.645036	0.004091	5.332186
47	569219	4972053	2.143229	0.909655	0.05108	0.001883	0.420756	1.04665	0.079232	0.063891	0.591208	0.003637	5.31122
48	569269	4972033	2.265793	0.542732	0.054473	0.000933	0.230357	1.188326	0.08844	0.069058	0.851715	0.004091	5.295918
49	569229	4972073	2.217704	0.813375	0.052991	0.001626	0.369928	1.086342	0.082335	0.066573	0.599473	0.004091	5.294438
50	569216.9	4972049	2.104856	0.932188	0.050115	0.001948	0.433148	1.026166	0.07767	0.062606	0.581675	0.003637	5.274009
51	569249	4972073	2.296722	0.637325	0.055116	0.001164	0.278142	1.147672	0.086689	0.069687	0.6658	0.004091	5.242408
52	569219	4972063	2.111423	0.919054	0.050294	0.001912	0.426278	1.024733	0.077702	0.062861	0.562544	0.003637	5.240437
53	569259	4972063	2.287736	0.575026	0.054955	0.00101	0.246401	1.159275	0.087236	0.069631	0.711829	0.004091	5.19719
54	569239	4972083	2.225497	0.712396	0.053294	0.001369	0.318056	1.0953	0.083027	0.067183	0.600307	0.004091	5.16052
55	569229	4972083	2.158057	0.807109	0.051544	0.001621	0.367971	1.050941	0.079787	0.064726	0.562877	0.004091	5.148725
56	569219	4972073	2.073299	0.917849	0.049365	0.001917	0.426452	1.000683	0.075997	0.061669	0.534447	0.003637	5.145313
57	569269	4972043	2.226878	0.534177	0.053526	0.000919	0.226748	1.155033	0.086274	0.067869	0.788155	0.004091	5.14367
58	569213.1	4972058	2.002297	0.993884	0.047561	0.002124	0.466888	0.963341	0.073084	0.059169	0.525248	0.003637	5.137232
59	569249	4972083	2.225099	0.63624	0.053366	0.001176	0.279055	1.10423	0.083576	0.067446	0.619705	0.004091	5.073983
60	569219	4972083	2.030114	0.906522	0.048329	0.001898	0.421582	0.975254	0.074172	0.060357	0.507383	0.003637	5.029247
61	569259	4972073	2.221783	0.570568	0.053366	0.001012	0.245488	1.117417	0.084281	0.067579	0.6618	0.004091	5.027384
62	569209.3	4972067	1.903119	1.05076	0.045079	0.002286	0.498107	0.903929	0.068719	0.055856	0.475286	0.003182	5.006322

63	569239	4972093	2.156665	0.705528	0.051633	0.001364	0.315969	1.05516	0.080124	0.065051	0.561077	0.004091	4.996663
64	569229	4972093	2.097166	0.793252	0.050079	0.001598	0.362145	1.016132	0.077264	0.06287	0.52898	0.003637	4.993123
65	569269	4972053	2.181989	0.525621	0.052455	0.000905	0.223313	1.120919	0.083988	0.066494	0.731527	0.004091	4.991302
66	569209	4972073	1.883942	1.04594	0.044614	0.002276	0.495976	0.892038	0.067879	0.055273	0.461054	0.003182	4.952175
67	569276.5	4971977	1.828172	0.432113	0.043953	0.000738	0.182833	1.097079	0.078389	0.055741	1.222778	0.003182	4.944979
68	569249	4972093	2.155072	0.634915	0.051669	0.001186	0.279881	1.062799	0.080585	0.065257	0.578575	0.004091	4.914029
69	569205.6	4972075	1.814384	1.102575	0.042864	0.002433	0.526456	0.852072	0.064978	0.052889	0.444156	0.003182	4.905988
70	569219	4972093	1.984066	0.890013	0.047222	0.001864	0.41406	0.949243	0.072289	0.058974	0.481919	0.003637	4.903287
71	569209	4972083	1.859456	1.025576	0.044043	0.002231	0.486063	0.877601	0.066864	0.05458	0.442956	0.003182	4.862551
72	569229	4972103	2.036598	0.775659	0.048633	0.001564	0.354406	0.982392	0.074807	0.061034	0.498284	0.003637	4.837013
73	569239	4972103	2.089166	0.695285	0.050008	0.001352	0.312186	1.016946	0.07734	0.062972	0.526114	0.003637	4.835007
74	569279	4972003	1.948472	0.463684	0.046847	0.000795	0.19653	1.079918	0.078971	0.059398	0.953738	0.003637	4.831989
75	569279	4972013	1.980585	0.480193	0.047615	0.000829	0.204269	1.076401	0.079183	0.060346	0.889011	0.003637	4.822068
76	569279	4971993	1.894278	0.44332	0.045543	0.000752	0.187225	1.074962	0.078051	0.057772	1.022564	0.003637	4.808103
77	569250	4972100	2.103602	0.623467	0.050437	0.001167	0.275098	1.033868	0.078477	0.063686	0.551912	0.003637	4.785349
78	569201.8	4972084	1.726035	1.144629	0.040667	0.002557	0.549848	0.801138	0.061197	0.049967	0.40506	0.003182	4.78428
79	569279	4972023	1.99414	0.488025	0.047918	0.000848	0.208052	1.06627	0.078839	0.060742	0.829017	0.003637	4.777487
80	569209	4972093	1.831575	1.006657	0.0434	0.002188	0.476976	0.861872	0.065737	0.053773	0.425991	0.003182	4.771351
81	569219	4972103	1.935565	0.866998	0.046079	0.001814	0.403277	0.922693	0.070358	0.057538	0.457321	0.003637	4.76528
82	569279	4971983	1.814639	0.423558	0.043632	0.000719	0.17879	1.059436	0.076275	0.055348	1.094224	0.003182	4.749802
83	569275	4972050	2.061694	0.497183	0.049562	0.000857	0.211269	1.065539	0.079673	0.062826	0.715295	0.003637	4.747534
84	569229	4972113	1.977923	0.762886	0.047222	0.001545	0.349101	0.950389	0.072453	0.059242	0.471886	0.003637	4.696283
85	569239	4972113	2.023638	0.685284	0.048418	0.001341	0.308447	0.98071	0.074682	0.060955	0.49565	0.003637	4.682762
86	569199	4972093	1.660343	1.16415	0.03906	0.002619	0.561196	0.763971	0.058438	0.047838	0.376162	0.002728	4.676505
87	569198	4972093	1.643226	1.183069	0.038613	0.002669	0.57124	0.754108	0.057694	0.047233	0.371063	0.002728	4.671643
88	569209	4972103	1.798846	0.981232	0.042632	0.002131	0.464627	0.844235	0.064464	0.05284	0.408559	0.003182	4.662748
89	569219	4972113	1.887738	0.848682	0.044936	0.001779	0.394929	0.896941	0.068468	0.056106	0.43549	0.003182	4.638249
90	569199	4972103	1.641821	1.127037	0.038649	0.002529	0.542544	0.75463	0.05777	0.047391	0.36333	0.002728	4.578428
91	569194.2	4972101	1.564012	1.211507	0.036667	0.002757	0.587415	0.709998	0.0544	0.044647	0.340499	0.002728	4.55463
92	569229	4972123	1.920005	0.745654	0.045829	0.001512	0.341449	0.919295	0.070163	0.05749	0.446822	0.003637	4.551855
93	569209	4972113	1.763835	0.954963	0.04181	0.002071	0.451888	0.825794	0.063119	0.051837	0.391728	0.003182	4.550227
94	569239	4972123	1.960287	0.672993	0.0469	0.001321	0.303447	0.946265	0.072145	0.059014	0.46792	0.003637	4.533929

95	569219	4972123	1.840073	0.830848	0.043793	0.001743	0.386755	0.871616	0.066602	0.054676	0.415192	0.003182	4.514479
96	569199	4972113	1.621361	1.093899	0.038185	0.00245	0.526021	0.744482	0.057029	0.04687	0.351298	0.002728	4.484322
97	569209	4972123	1.729146	0.934839	0.040989	0.002026	0.442279	0.807667	0.061789	0.050823	0.376762	0.003182	4.449502
98	569190.4	4972110	1.491087	1.235125	0.034863	0.002831	0.601024	0.669966	0.051395	0.042276	0.313702	0.002728	4.444996
99	569275	4972075	1.967363	0.481759	0.047275	0.000836	0.205356	0.996175	0.074991	0.059927	0.605906	0.003637	4.443225
100	569250	4972125	1.94176	0.608766	0.046525	0.001162	0.270967	0.943156	0.071836	0.058665	0.474119	0.003637	4.420594
101	569229	4972133	1.864054	0.729989	0.044489	0.001483	0.334622	0.889587	0.067966	0.055792	0.424124	0.003182	4.41529
102	569219	4972133	1.792726	0.812291	0.042668	0.001705	0.378276	0.846798	0.064765	0.053259	0.396127	0.003182	4.391797
103	569199	4972123	1.597913	1.059195	0.037649	0.002367	0.508716	0.733088	0.056191	0.046259	0.339399	0.002728	4.383504
104	569209	4972133	1.692536	0.910619	0.040114	0.001971	0.430626	0.788938	0.060408	0.049763	0.361931	0.003182	4.340087
105	569186.7	4972119	1.424488	1.246693	0.033237	0.002874	0.608285	0.634338	0.048714	0.040147	0.290838	0.002273	4.331887
106	569189	4972123	1.453231	1.189576	0.033988	0.002724	0.578458	0.651716	0.050038	0.041253	0.29737	0.002273	4.300627
107	569229	4972143	1.81022	0.716132	0.043203	0.001457	0.328665	0.86127	0.065863	0.054155	0.403526	0.003182	4.287674
108	569199	4972133	1.572122	1.023286	0.03706	0.002281	0.490846	0.72075	0.05528	0.04558	0.327767	0.002728	4.277699
109	569219	4972143	1.746042	0.793252	0.04156	0.001667	0.369493	0.822581	0.06297	0.051863	0.378296	0.003182	4.270905
110	569209	4972143	1.654357	0.88206	0.039221	0.001907	0.416843	0.769779	0.058991	0.048668	0.347199	0.002728	4.221752
111	569182.9	4972128	1.358939	1.244524	0.031648	0.002881	0.608503	0.600253	0.046144	0.038099	0.269573	0.002273	4.202836
112	569189	4972133	1.4374	1.137761	0.033666	0.002595	0.55224	0.645585	0.049591	0.040944	0.289604	0.002273	4.19166
113	569199	4972143	1.54461	0.986775	0.036434	0.002193	0.472758	0.707756	0.054316	0.04485	0.316435	0.002728	4.168854
114	569275	4972100	1.858404	0.477301	0.044632	0.000845	0.205356	0.925936	0.070057	0.056528	0.520081	0.003182	4.162321
115	569219	4972153	1.700379	0.774333	0.040471	0.001626	0.360754	0.799157	0.061228	0.050501	0.361697	0.003182	4.153327
116	569209	4972153	1.617642	0.858683	0.038363	0.001855	0.405581	0.751434	0.057627	0.047602	0.334167	0.002728	4.115682
117	569285	4971977	1.502975	0.381744	0.036113	0.000674	0.16392	0.900377	0.064309	0.045728	1.002866	0.002728	4.101433
118	569289	4972023	1.688751	0.432354	0.04056	0.000764	0.185964	0.907554	0.066956	0.051369	0.722594	0.003182	4.10005
119	569289	4972013	1.654519	0.421509	0.039739	0.000745	0.181094	0.903433	0.06632	0.050336	0.762157	0.003182	4.083034
120	569189	4972143	1.4192	1.087031	0.033273	0.002471	0.52663	0.638309	0.049055	0.040557	0.281739	0.002273	4.080538
121	569250	4972150	1.794591	0.581051	0.042971	0.001121	0.259837	0.863905	0.065986	0.054154	0.412859	0.003182	4.079657
122	569175.3	4972145	1.255309	1.296339	0.029058	0.003031	0.637156	0.543841	0.041862	0.034664	0.236043	0.002273	4.079576
123	569283	4971773	1.93646	0.332701	0.046704	0.000464	0.129657	0.969997	0.073473	0.059497	0.525814	0.003637	4.078404
124	569283	4971763	1.981537	0.33005	0.047793	0.00045	0.127353	0.975227	0.074376	0.060921	0.473519	0.003637	4.074862
125	569179.1	4972136	1.298057	1.233438	0.030183	0.002864	0.604024	0.569395	0.043811	0.036231	0.251042	0.002273	4.071319
126	569199	4972153	1.515935	0.950384	0.035791	0.002107	0.454627	0.694314	0.053314	0.044083	0.305503	0.002728	4.058785

127	569283	4971753	2.00375	0.326314	0.048347	0.000436	0.124962	0.973033	0.074599	0.061631	0.430257	0.003637	4.046965
128	569219	4972163	1.656769	0.758909	0.039417	0.001595	0.353753	0.77694	0.059569	0.04919	0.346865	0.003182	4.046189
129	569289	4972003	1.604101	0.404278	0.038542	0.000712	0.173355	0.892521	0.06514	0.048818	0.80182	0.002728	4.032014
130	569209	4972163	1.581117	0.834945	0.037506	0.001802	0.39419	0.733386	0.05628	0.046543	0.321801	0.002728	4.010297
131	569179	4972143	1.288842	1.18801	0.030005	0.00275	0.58098	0.566772	0.04362	0.036106	0.247175	0.002273	3.986533
132	569283	4971743	1.992288	0.320048	0.048079	0.000424	0.122048	0.95775	0.073719	0.061295	0.392061	0.003637	3.971349
133	569189	4972153	1.399202	1.038108	0.032845	0.00235	0.501977	0.630126	0.04845	0.040107	0.273873	0.002273	3.96931
134	569289	4971993	1.536052	0.385239	0.036899	0.000676	0.165007	0.873525	0.063331	0.046753	0.840083	0.002728	3.950292
135	569199	4972163	1.486513	0.914234	0.035113	0.002021	0.436757	0.680611	0.052291	0.043291	0.294971	0.002728	3.948529
136	569283	4971783	1.793667	0.327278	0.043239	0.000479	0.129918	0.923055	0.069203	0.05504	0.580109	0.003182	3.92517
137	569225	4972175	1.635842	0.698418	0.038988	0.001448	0.323187	0.769354	0.059005	0.048753	0.341166	0.002728	3.918887
138	569275	4972125	1.74723	0.47959	0.041935	0.000874	0.208834	0.859029	0.06525	0.053035	0.451755	0.003182	3.910714
139	569171.6	4972154	1.197705	1.249103	0.027719	0.002921	0.614112	0.517008	0.039832	0.033028	0.220711	0.001818	3.903958
140	569209	4972173	1.543695	0.806989	0.036613	0.001738	0.380667	0.715173	0.054919	0.045471	0.309436	0.002728	3.89743
141	569179	4972153	1.276399	1.125108	0.029773	0.002593	0.548979	0.563344	0.043373	0.035943	0.242076	0.002273	3.869859
142	569189	4972163	1.377873	0.991233	0.03238	0.002236	0.478411	0.621262	0.047789	0.039608	0.266107	0.002273	3.859171
143	569283	4971733	1.949701	0.311372	0.047043	0.00041	0.118483	0.930032	0.071803	0.059992	0.357498	0.003637	3.849969
144	569199	4972173	1.456696	0.878927	0.034434	0.001938	0.419278	0.666796	0.051255	0.042485	0.284838	0.002728	3.839375
145	569289	4971983	1.449339	0.367405	0.034827	0.000648	0.157659	0.845368	0.060818	0.044101	0.875046	0.002728	3.837937
146	569250	4972175	1.665102	0.562253	0.039846	0.001098	0.252923	0.795766	0.060908	0.050163	0.366097	0.003182	3.797337
147	569209	4972183	1.507628	0.781804	0.035774	0.001683	0.368537	0.697684	0.053608	0.044432	0.298104	0.002728	3.791981
148	569179	4972163	1.262335	1.066184	0.029505	0.002448	0.519151	0.558954	0.043049	0.035715	0.236843	0.002273	3.756457
149	569225	4972200	1.535862	0.719144	0.036524	0.001519	0.335927	0.715633	0.054943	0.045545	0.30467	0.002728	3.752493
150	569189	4972173	1.355546	0.946528	0.031898	0.002129	0.455975	0.611879	0.047087	0.03907	0.258441	0.002273	3.750824
151	569169	4972163	1.157568	1.189335	0.026808	0.002779	0.584328	0.499819	0.038528	0.031986	0.210112	0.001818	3.743081
152	569167.8	4972163	1.14468	1.199457	0.026486	0.002807	0.589763	0.492863	0.037996	0.031546	0.207113	0.001818	3.734529
153	569199	4972183	1.426752	0.844585	0.033738	0.001857	0.402277	0.652961	0.050217	0.04167	0.275106	0.002728	3.73189
154	569283	4971723	1.903529	0.303058	0.045936	0.000398	0.115179	0.902201	0.06983	0.058574	0.328201	0.003637	3.730541
155	569199	4972193	1.405821	0.868805	0.033202	0.001921	0.415147	0.640569	0.049279	0.040928	0.266907	0.002273	3.724851
156	569209	4972193	1.473351	0.760235	0.03497	0.001633	0.358188	0.681058	0.052347	0.043436	0.286738	0.002728	3.694684
157	569289	4971753	1.802279	0.30354	0.043471	0.000417	0.11757	0.880811	0.067356	0.055397	0.409892	0.003182	3.683914
158	569289	4971763	1.76665	0.30607	0.042596	0.000431	0.11957	0.875776	0.066602	0.054271	0.448222	0.003182	3.68337

159	569209	4972203	1.44501	0.785781	0.034238	0.001705	0.371884	0.664728	0.051116	0.042456	0.276506	0.002728	3.67615
160	569275	4972150	1.638676	0.473204	0.039292	0.000879	0.207921	0.797168	0.060745	0.049656	0.396627	0.003182	3.66735
161	569283	4971793	1.578167	0.316554	0.038006	0.000493	0.128875	0.846105	0.062486	0.048323	0.640436	0.002728	3.662173
162	569179	4972173	1.246987	1.011598	0.029183	0.002312	0.491498	0.553734	0.042661	0.035431	0.231477	0.002273	3.647154
163	569189	4972183	1.332546	0.904112	0.03138	0.002024	0.434757	0.602086	0.046354	0.038502	0.250942	0.002273	3.644974
164	569289	4971743	1.809365	0.299081	0.04365	0.000405	0.115135	0.874688	0.067175	0.055635	0.375829	0.003182	3.644144
165	569289	4971773	1.697508	0.306191	0.040917	0.000445	0.121135	0.857699	0.064754	0.052102	0.491951	0.003182	3.635884
166	569189	4972193	1.318417	0.915559	0.031023	0.002057	0.440887	0.593947	0.045736	0.038019	0.244976	0.002273	3.632893
167	569169	4972173	1.14819	1.117517	0.026665	0.0026	0.547718	0.498701	0.03845	0.031953	0.207013	0.001818	3.620624
168	569199	4972203	1.377047	0.832414	0.032541	0.001836	0.397146	0.627704	0.048308	0.040157	0.258541	0.002273	3.617967
169	569283	4971713	1.845773	0.2939	0.044543	0.000386	0.1117	0.870323	0.067498	0.056797	0.30207	0.003637	3.596626
170	569164	4972171	1.095698	1.15198	0.025361	0.002695	0.566414	0.470783	0.036313	0.030183	0.195047	0.001818	3.576294
171	569289	4971733	1.790207	0.292695	0.043185	0.000393	0.112265	0.85812	0.066121	0.055058	0.344966	0.003182	3.566192
172	569179	4972183	1.230575	0.960867	0.028844	0.002188	0.465845	0.547825	0.042221	0.035101	0.226077	0.002273	3.541816
173	569250	4972200	1.550041	0.542371	0.037077	0.001069	0.245097	0.73601	0.056407	0.046629	0.323868	0.002728	3.541297
174	569189	4972203	1.295645	0.873384	0.030523	0.001955	0.419756	0.584477	0.045021	0.037457	0.238343	0.002273	3.528833
175	569199	4972213	1.348229	0.797469	0.03188	0.001752	0.379841	0.614778	0.047332	0.039381	0.250375	0.002273	3.51331
176	569179	4972193	1.220827	0.954481	0.028612	0.002174	0.462801	0.542912	0.041849	0.034819	0.221645	0.002273	3.512391
177	569164	4972177	1.090322	1.108238	0.025272	0.002586	0.544152	0.470269	0.036279	0.030172	0.193414	0.001818	3.502522
178	569169	4972183	1.135099	1.049555	0.026433	0.002431	0.513238	0.495458	0.038214	0.031788	0.203046	0.001818	3.49708
179	569289	4971723	1.763745	0.286067	0.04256	0.000381	0.109439	0.839608	0.064869	0.054253	0.318435	0.003182	3.482539
180	569299	4972023	1.414533	0.38319	0.033952	0.000693	0.166485	0.762466	0.056161	0.042951	0.617472	0.002728	3.48063
181	569225	4972225	1.435822	0.660943	0.034166	0.001391	0.308186	0.667076	0.051285	0.04262	0.275306	0.002728	3.479523
182	569300	4972050	1.455408	0.383672	0.034952	0.000688	0.165876	0.761127	0.056631	0.044232	0.544179	0.002728	3.449492
183	569289	4971783	1.541809	0.299202	0.037149	0.000457	0.120831	0.801894	0.059888	0.047247	0.53498	0.002728	3.446183
184	569275	4972175	1.537345	0.461033	0.036845	0.000867	0.203747	0.741922	0.056673	0.046524	0.353298	0.002728	3.440982
185	569283	4971703	1.773274	0.283537	0.042793	0.000374	0.107961	0.832597	0.064679	0.054561	0.277939	0.003182	3.440896
186	569164	4972183	1.084291	1.066907	0.025165	0.002483	0.523108	0.469301	0.036211	0.030132	0.191581	0.001818	3.430998
187	569189	4972213	1.272797	0.83386	0.030005	0.00186	0.399973	0.574876	0.044296	0.036885	0.231877	0.002273	3.4287
188	569299	4972013	1.37153	0.370779	0.032916	0.000671	0.16105	0.75025	0.055005	0.041649	0.640536	0.002728	3.427114
189	569179	4972203	1.205874	0.908811	0.028308	0.002062	0.439713	0.537675	0.041452	0.034516	0.217245	0.002273	3.417929
190	569293.5	4971977	1.251318	0.337641	0.030041	0.00061	0.146571	0.741645	0.053082	0.038	0.805719	0.002273	3.4069

191	569200	4972225	1.321991	0.755897	0.031291	0.001652	0.359101	0.603566	0.046484	0.038708	0.242976	0.002273	3.403939
192	569169	4972193	1.12567	0.992559	0.026254	0.002288	0.484193	0.493588	0.038075	0.031698	0.200047	0.001818	3.39619
193	569289	4971713	1.723742	0.278717	0.041596	0.000369	0.106483	0.815968	0.063182	0.053027	0.294471	0.003182	3.380735
194	569300	4972075	1.466189	0.375237	0.03522	0.000664	0.161354	0.751088	0.056285	0.044599	0.486785	0.002728	3.380148
195	569299	4972003	1.316803	0.354391	0.031612	0.00064	0.153789	0.732542	0.053427	0.039993	0.661567	0.002273	3.347037
196	569189	4972223	1.252166	0.798554	0.029558	0.001774	0.382363	0.566249	0.04364	0.036366	0.226111	0.002273	3.339054
197	569179	4972213	1.191264	0.866757	0.027987	0.001957	0.418495	0.53244	0.041054	0.034209	0.212945	0.002273	3.329381
198	569283	4971803	1.311286	0.301853	0.031541	0.00051	0.126962	0.748628	0.054085	0.040012	0.708729	0.002273	3.325878
199	569169	4972203	1.116206	0.940864	0.026093	0.00216	0.457931	0.491454	0.037914	0.031589	0.19708	0.001818	3.30311
200	569250	4972225	1.444596	0.512487	0.034541	0.001014	0.231966	0.682411	0.052417	0.043433	0.292671	0.002728	3.298263
201	569154.6	4972183	0.990813	1.08932	0.022879	0.002557	0.536456	0.421823	0.032572	0.027121	0.17095	0.001818	3.296308
202	569283	4971693	1.703918	0.273776	0.041114	0.000362	0.104396	0.797108	0.062009	0.052422	0.256941	0.003182	3.295228
203	569300	4972100	1.445684	0.369212	0.03472	0.000652	0.158702	0.728587	0.054906	0.043979	0.43469	0.002728	3.273859
204	569159	4972193	1.029778	1.018345	0.023897	0.002371	0.499368	0.444718	0.03433	0.028599	0.178849	0.001818	3.262073
205	569289	4971703	1.669186	0.270041	0.040274	0.00036	0.103222	0.786476	0.061009	0.051347	0.272206	0.003182	3.257302
206	569299	4971993	1.250358	0.337521	0.030023	0.00061	0.146571	0.708897	0.051401	0.037971	0.679699	0.002273	3.245323
207	569179	4972223	1.175228	0.82651	0.027647	0.00186	0.39819	0.526381	0.040596	0.033853	0.208379	0.001818	3.240462
208	569275	4972200	1.443146	0.444404	0.034577	0.000843	0.197182	0.691879	0.05296	0.043633	0.316868	0.002728	3.228219
209	569169	4972213	1.104946	0.892423	0.025861	0.002038	0.433365	0.488215	0.037671	0.031411	0.193681	0.001818	3.211429
210	569289	4971793	1.336146	0.288598	0.032148	0.000471	0.1197	0.725227	0.053333	0.040838	0.581709	0.002273	3.180442
211	569225	4972250	1.339832	0.570447	0.031934	0.001181	0.263837	0.62277	0.047944	0.039939	0.249275	0.002273	3.169432
212	569159	4972203	1.022071	0.959903	0.02379	0.002226	0.469628	0.443807	0.034266	0.028569	0.176516	0.001818	3.162593
213	569145.3	4972183	0.906035	1.098478	0.020807	0.002598	0.542848	0.379639	0.029325	0.02443	0.152785	0.001364	3.158307
214	569300	4972125	1.40674	0.369694	0.033773	0.000662	0.159789	0.699348	0.052937	0.042757	0.388928	0.002728	3.157355
215	569200	4972250	1.248582	0.678295	0.029594	0.001471	0.320839	0.570197	0.043965	0.036688	0.223244	0.002273	3.155148
216	569283	4971683	1.635366	0.264377	0.039453	0.00035	0.101004	0.762605	0.059399	0.050308	0.23831	0.003182	3.154353
217	569299	4971753	1.511956	0.270161	0.036452	0.00039	0.10657	0.744747	0.056773	0.046416	0.369096	0.002728	3.145289
218	569299	4971743	1.532574	0.267149	0.036952	0.000379	0.104613	0.746409	0.05715	0.047073	0.341899	0.002728	3.136926
219	569289	4971693	1.613697	0.261606	0.038935	0.000348	0.100091	0.757322	0.058838	0.049638	0.252541	0.003182	3.136198
220	569169	4972223	1.093491	0.847959	0.025647	0.001929	0.410886	0.484675	0.037405	0.031212	0.190314	0.001818	3.125336
221	569299	4971983	1.172831	0.322217	0.028147	0.000586	0.14031	0.679391	0.048935	0.035597	0.694397	0.002273	3.124684
222	569149	4972193	0.934933	1.028708	0.021593	0.002417	0.506542	0.397344	0.030696	0.025588	0.158518	0.001364	3.107701

223	569299	4971733	1.536224	0.263052	0.037042	0.000367	0.102395	0.741431	0.056969	0.047203	0.317235	0.002728	3.104644
224	569299	4971763	1.458048	0.270523	0.035148	0.0004	0.10783	0.728957	0.055252	0.044725	0.397327	0.002728	3.100938
225	569299	4971723	1.536405	0.259075	0.03706	0.000357	0.100395	0.73589	0.056712	0.047224	0.29607	0.002728	3.071916
226	569159	4972213	1.01383	0.907004	0.023647	0.002093	0.442713	0.442329	0.034159	0.028501	0.174083	0.001818	3.070177
227	569250	4972250	1.34906	0.475855	0.032255	0.00094	0.215226	0.634378	0.048812	0.040571	0.262107	0.002273	3.061477
228	569300	4972150	1.357546	0.374273	0.032577	0.000683	0.163094	0.667042	0.050673	0.041202	0.349298	0.002273	3.038661
229	569289	4971683	1.558576	0.253532	0.037595	0.000338	0.097091	0.72894	0.056708	0.047939	0.235077	0.002728	3.018524
230	569186.1	4971660	1.560186	0.317277	0.037577	0.0005	0.12957	0.704936	0.055508	0.047759	0.159851	0.002728	3.015891
231	569194.2	4971654	1.566208	0.310408	0.03772	0.000481	0.125918	0.707965	0.05575	0.047973	0.160117	0.002728	3.015269
232	569275	4972225	1.35337	0.418497	0.032434	0.000795	0.185834	0.644991	0.049474	0.040913	0.283205	0.002273	3.011784
233	569299	4971713	1.517211	0.253653	0.036595	0.000348	0.098004	0.722285	0.055796	0.046642	0.275939	0.002728	3.009199
234	569149	4972203	0.929059	0.96641	0.021521	0.00226	0.474845	0.397557	0.03072	0.025629	0.156884	0.001364	3.00625
235	569299	4971773	1.368673	0.267872	0.03297	0.000412	0.108352	0.698098	0.052517	0.041933	0.426724	0.002728	3.000277
236	569283	4971673	1.555655	0.253773	0.037524	0.00034	0.097265	0.723529	0.056411	0.047847	0.220445	0.002728	2.995516
237	569178	4971665	1.541567	0.322699	0.037113	0.000517	0.132701	0.696295	0.054821	0.047155	0.158917	0.002728	2.994513
238	569202.2	4971649	1.560396	0.302214	0.037595	0.000462	0.121918	0.705783	0.055576	0.04782	0.159751	0.002728	2.994243
239	569159	4972223	1.007118	0.860129	0.023539	0.001976	0.418843	0.441333	0.034085	0.02846	0.171916	0.001818	2.989219
240	569179	4971663	1.535383	0.319928	0.03697	0.00051	0.131397	0.693457	0.054601	0.046972	0.157818	0.002728	2.979762
241	569135.9	4972183	0.815807	1.083174	0.018646	0.002576	0.536804	0.336078	0.025981	0.021656	0.134387	0.001364	2.976473
242	569210.3	4971643	1.544536	0.293056	0.03722	0.00044	0.117526	0.69917	0.055047	0.047357	0.158984	0.002728	2.956065
243	569175	4972250	1.094631	0.732038	0.02579	0.001636	0.351492	0.49069	0.03789	0.031667	0.188381	0.001818	2.956033
244	569225	4972275	1.257725	0.524778	0.029987	0.001081	0.242184	0.583312	0.044988	0.037531	0.229844	0.002273	2.953702
245	569309	4972023	1.186445	0.340895	0.028451	0.000631	0.149615	0.639717	0.047083	0.035956	0.522048	0.002273	2.953113
246	569189	4971653	1.529714	0.307757	0.036845	0.000481	0.125309	0.691018	0.054424	0.046838	0.155651	0.002728	2.950765
247	569209	4971643	1.540605	0.293297	0.037131	0.000443	0.117744	0.697243	0.054899	0.047232	0.158251	0.002728	2.949572
248	569139	4972193	0.843705	1.021479	0.019378	0.002414	0.504672	0.352896	0.027281	0.022754	0.139786	0.001364	2.935729
249	569299	4971703	1.487173	0.247387	0.035881	0.000336	0.095439	0.704393	0.054523	0.045723	0.257274	0.002728	2.930855
250	569200	4972275	1.180074	0.610574	0.028004	0.001312	0.28762	0.538973	0.041603	0.034786	0.205513	0.002273	2.930732
251	569149	4972213	0.924738	0.911703	0.021468	0.002121	0.446931	0.398169	0.030772	0.025691	0.155518	0.001364	2.918474
252	569283	4971812	1.001401	0.284019	0.024022	0.000524	0.124309	0.630495	0.044135	0.030363	0.773456	0.001818	2.914542
253	569300	4972175	1.302821	0.373671	0.031255	0.00069	0.163963	0.634018	0.048306	0.039489	0.315135	0.002273	2.911621
254	569159	4972233	0.996211	0.815183	0.023325	0.001864	0.396059	0.438111	0.033846	0.028281	0.168983	0.001818	2.90368

255	569168.8	4971668	1.486187	0.321494	0.035774	0.000524	0.133266	0.670999	0.052822	0.045423	0.154151	0.002728	2.903368
256	569218.4	4971638	1.518892	0.282934	0.036613	0.000421	0.112918	0.688243	0.054173	0.046589	0.157718	0.002728	2.901228
257	569199	4971643	1.504206	0.29402	0.036238	0.00045	0.118874	0.67981	0.053546	0.046088	0.152585	0.002728	2.888545
258	569309	4972013	1.143723	0.328363	0.027433	0.000607	0.144093	0.624778	0.045795	0.034662	0.534347	0.002273	2.886072
259	569289	4971673	1.490697	0.244254	0.03597	0.000329	0.093743	0.695204	0.054144	0.045846	0.218145	0.002728	2.881057
260	569302	4971977	1.054214	0.304383	0.02529	0.000564	0.133658	0.619406	0.044417	0.031944	0.6618	0.001818	2.877494
261	569283	4971663	1.491387	0.245218	0.035988	0.000331	0.094178	0.692041	0.054002	0.045864	0.206013	0.002728	2.867749
262	569289	4971803	1.098529	0.275825	0.026397	0.000483	0.118092	0.635142	0.04571	0.033437	0.631737	0.001818	2.867169
263	569250	4972275	1.264913	0.444525	0.030255	0.000879	0.200921	0.592474	0.045657	0.038046	0.236876	0.002273	2.856819
264	569299	4971693	1.454574	0.241241	0.035095	0.000329	0.09296	0.68593	0.053185	0.044723	0.240609	0.002728	2.851374
265	569169	4971663	1.457855	0.313421	0.035095	0.00051	0.129744	0.657974	0.051808	0.044565	0.150018	0.002728	2.843716
266	569179	4971653	1.46776	0.303901	0.035345	0.000483	0.124614	0.662435	0.052178	0.04491	0.148852	0.002728	2.843205
267	569139	4972203	0.841791	0.959783	0.019414	0.00226	0.473149	0.355073	0.027455	0.022917	0.139119	0.001364	2.842323
268	569149	4972223	0.920671	0.862539	0.021432	0.001998	0.421843	0.398622	0.030811	0.025741	0.154151	0.001364	2.839171
269	569219	4971633	1.484346	0.276789	0.035774	0.000412	0.110483	0.672448	0.052934	0.045529	0.153651	0.002728	2.835092
270	569226.5	4971632	1.484927	0.27221	0.035791	0.0004	0.108135	0.673645	0.053005	0.045564	0.156118	0.002728	2.832522
271	569299	4971783	1.232496	0.261726	0.029665	0.000421	0.108091	0.646608	0.048141	0.037686	0.455321	0.002273	2.82243
272	569189	4971643	1.457696	0.292574	0.035113	0.000457	0.119048	0.658066	0.051843	0.044636	0.146652	0.002728	2.808813
273	569309	4972003	1.093681	0.313541	0.026236	0.000581	0.137571	0.60628	0.044238	0.033147	0.544912	0.001818	2.802005
274	569275	4972250	1.271028	0.386203	0.030469	0.000729	0.171007	0.602263	0.046303	0.038448	0.251842	0.002273	2.800564
275	569209	4971633	1.462794	0.279319	0.035256	0.000421	0.112265	0.661574	0.052103	0.044844	0.148785	0.002728	2.800089
276	569159.7	4971671	1.422212	0.318482	0.03422	0.000529	0.133049	0.641961	0.050524	0.043429	0.148985	0.002728	2.796118
277	569126.5	4972183	0.732084	1.048832	0.016646	0.002505	0.52089	0.296945	0.022971	0.019155	0.118188	0.001364	2.77958
278	569300	4972200	1.244742	0.363067	0.029844	0.000676	0.159702	0.601064	0.045914	0.037708	0.284805	0.002273	2.769795
279	569299	4971683	1.416897	0.234734	0.034184	0.000319	0.090438	0.665653	0.05169	0.043566	0.225311	0.002728	2.76552
280	569149	4972233	0.913661	0.816629	0.021307	0.001883	0.398451	0.397423	0.030725	0.025688	0.152185	0.001364	2.759316
281	569139	4972213	0.839279	0.904112	0.019414	0.002119	0.444713	0.356625	0.027581	0.023039	0.138286	0.001364	2.756532
282	569289	4971663	1.428276	0.235578	0.034452	0.000319	0.090612	0.664391	0.051794	0.04392	0.20328	0.002728	2.755349
283	569175	4972275	1.04554	0.649857	0.0247	0.001438	0.310491	0.470105	0.036338	0.030426	0.176049	0.001818	2.746762
284	569199	4971633	1.430755	0.279922	0.03447	0.000429	0.113178	0.646204	0.050911	0.043838	0.143686	0.002728	2.746118
285	569234.5	4971626	1.439948	0.260521	0.03472	0.000379	0.103091	0.65406	0.051443	0.044196	0.153585	0.002728	2.74467
286	569283	4971653	1.426888	0.236421	0.034416	0.000321	0.091091	0.660662	0.051597	0.043874	0.192347	0.002728	2.740345

287	569129	4972193	0.754851	0.994005	0.017253	0.002362	0.492368	0.310832	0.024047	0.020067	0.122388	0.001364	2.739535
288	569225	4972300	1.18229	0.473324	0.028219	0.000967	0.217357	0.547239	0.04227	0.035353	0.208446	0.002273	2.737736
289	569169	4971653	1.398978	0.297876	0.033684	0.000481	0.123005	0.630961	0.0497	0.042775	0.141886	0.002728	2.722073
290	569179	4971643	1.402942	0.288839	0.033791	0.000457	0.118353	0.632797	0.049858	0.042933	0.140586	0.002728	2.713283
291	569200	4972300	1.115287	0.537671	0.026522	0.00114	0.251662	0.510144	0.039435	0.033019	0.191181	0.001818	2.707881
292	569309	4971993	1.03709	0.299202	0.024879	0.000555	0.13144	0.584432	0.042427	0.031425	0.553845	0.001818	2.707112
293	569229	4971623	1.417886	0.260039	0.034184	0.000381	0.103309	0.643104	0.050606	0.043506	0.148652	0.002728	2.704394
294	569159	4971663	1.375742	0.305106	0.033112	0.000505	0.127179	0.620594	0.04886	0.042021	0.142186	0.002728	2.698033
295	569239	4971623	1.414878	0.254255	0.034113	0.000369	0.100395	0.64318	0.050573	0.043433	0.152385	0.002728	2.696308
296	569219	4971623	1.40935	0.264136	0.03397	0.000393	0.105569	0.638002	0.050236	0.043224	0.144519	0.002728	2.692126
297	569309	4971743	1.292359	0.239072	0.031148	0.000355	0.095265	0.633103	0.048357	0.039645	0.305236	0.002273	2.686813
298	569309	4971733	1.30525	0.23606	0.031469	0.000343	0.093439	0.633574	0.048566	0.040061	0.285838	0.002273	2.676873
299	569189	4971633	1.389692	0.278355	0.03347	0.000433	0.113222	0.62698	0.049408	0.042556	0.138386	0.002728	2.67523
300	569139	4972223	0.834762	0.85302	0.01936	0.001991	0.418669	0.356922	0.027612	0.023082	0.137053	0.001364	2.673834